COLLECTOR'S EDITION

ASIAN Geographic

passport

NO. 169

Ocean

TOURISM

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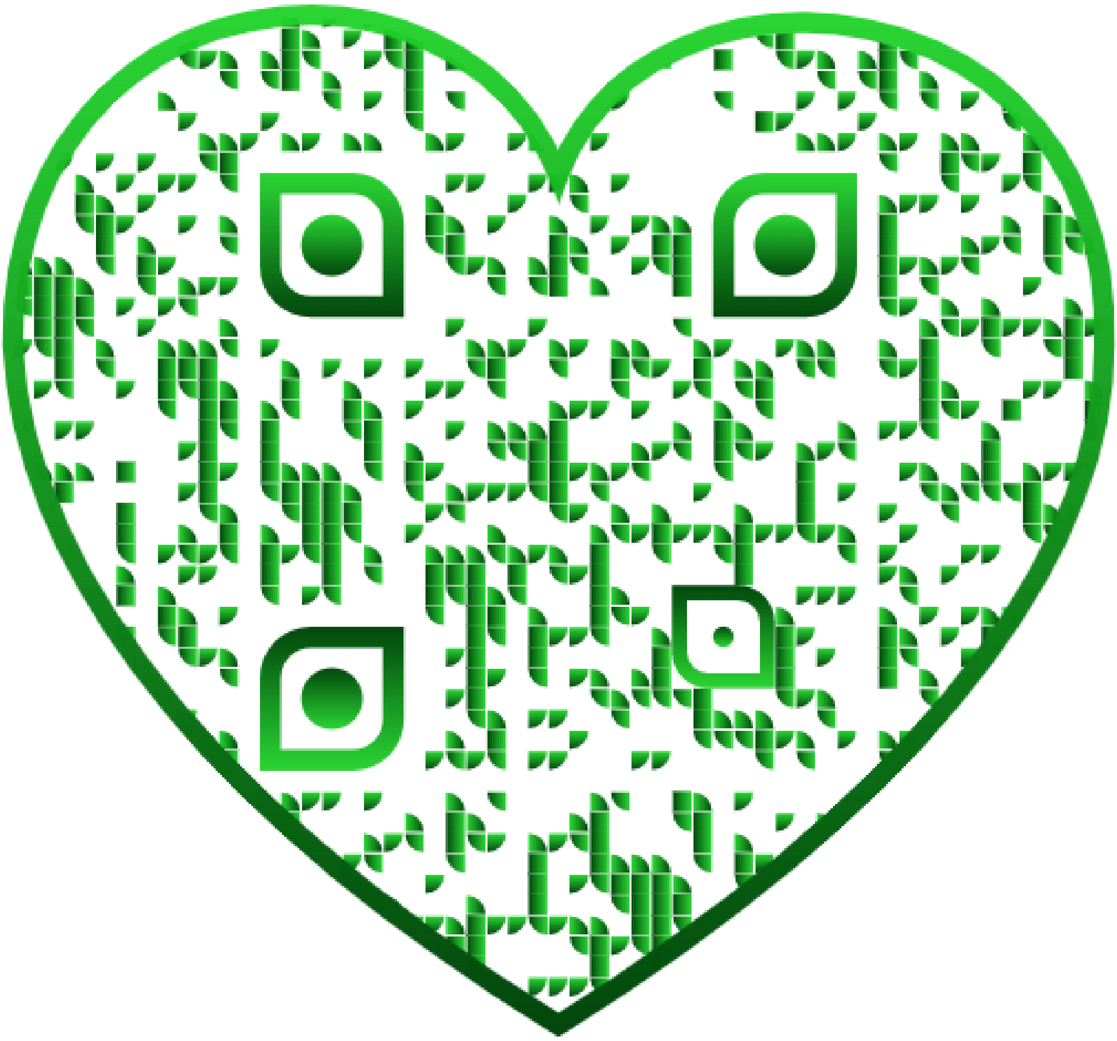


As part of ADEX's commitment to marine sustainability, entrants must adhere to ethical photographic principles, including capturing animals in their natural habitats exhibiting naturally occurring behaviour

PHOTO+VIDEO+ART COMPETITION

www.adex.asia

ADEX VOICE OF THE OCEAN

2026

12/04

LIVE JUDGING

SUNTEC SINGAPORE
CONVENTION &
EXHIBITION CENTRE

ADEX PHOTOGRAPHER OF THE YEAR (PORTFOLIO)

SEACAM

WORTH US$10,000

CATEGORIES

- Animal Behaviour
- Blackwater
- Conservation
- Smartphone
- Ocean Planet
  (Drone / Over-Under Photography)
- Underwater Arts
  (Underwater Model Photography / Artwork)
- Short Film
- Portfolio

SUBMISSION PERIOD
DEC 10, 2025 – MAR 10, 2026

Hosted by underwatercompetition.com

In association with DPG, THE REEF-WORLD FOUNDATION, GREEN FINS INTERNATIONAL COORDINATOR

Official Publication Scuba Diver ocean planet

Organised by underwater360

Images: VOO 2025 winners, runners-up and short-listed entries

SCUBA DIVER OCEAN PLANET: DIVE GUIDE 2026

IN CONJUNCTION WITH

ADEX
Wave of Hope for
OCEAN
TRIBES
Festival (Bali)

ScubaDiver oceanplanet
Dive Atlas of Indonesia
DIVE DIRECTORY INDONESIA

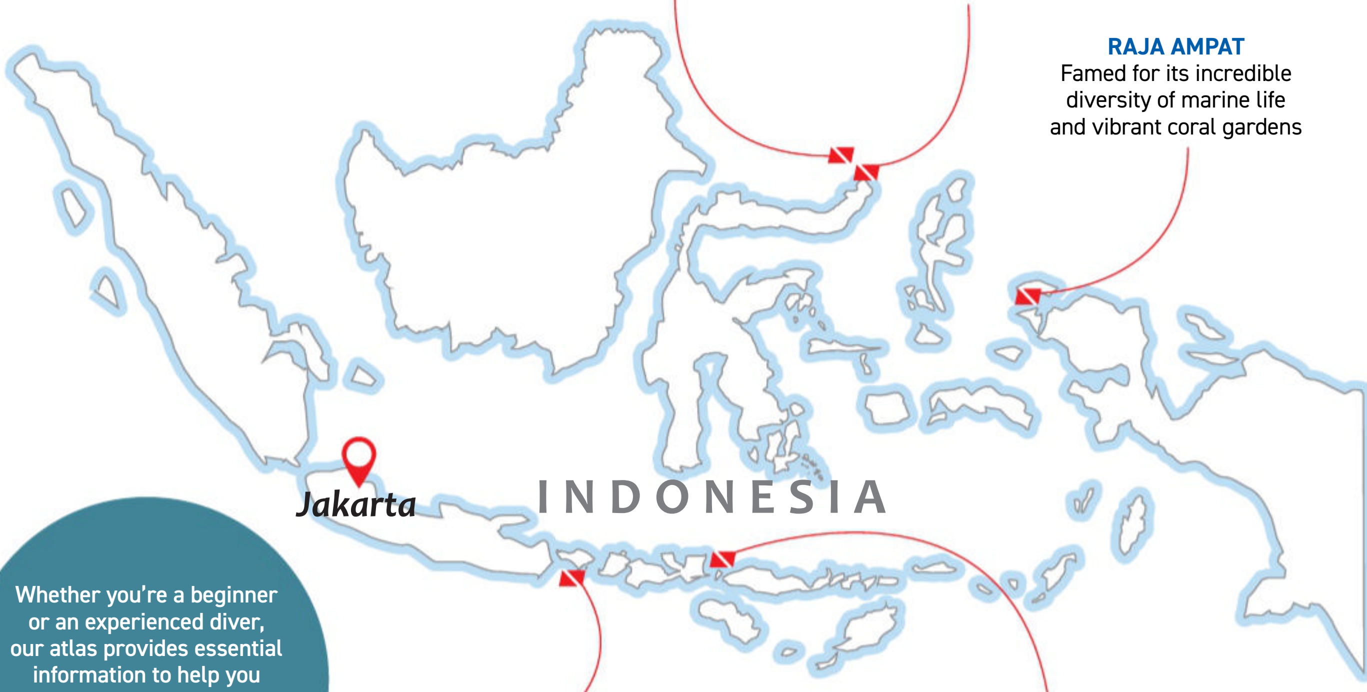
APRIL

DIVE ATLAS OF INDONESIA

GUIDE BOOK

ScubaDiver oceanplanet

A timeless collectible archiving the best dive sites in Indonesia with stunning detail and imagery. Known for its unparalleled biodiversity and vibrant reefs, Indonesia offers endless underwater thrills. The new master list for scuba divers, *Dive Atlas of Indonesia* immerses readers in top sites at locales such as:



BUNAKEN NATIONAL PARK
Offers stunning wall dives with abundant sea life

LEMBEH STRAIT
A macro diving paradise perfect for spotting rare critters

RAJA AMPAT
Famed for its incredible diversity of marine life and vibrant coral gardens

BALI (TULAMBEN & AMED)
Known for easy access to shipwrecks and rich marine ecosystems

KOMODO NATIONAL PARK
Home to thrilling drift dives and encounters with manta rays

Whether you're a beginner or an experienced diver, our atlas provides essential information to help you plan your diving adventures across Indonesia's breathtaking underwater landscapes

DIVE INTO THE UNDERWATER MARVELS OF THE PHILIPPINES

The allure of the Philippines extends far beyond its world-renowned islands and stunning beaches. Beneath this tropical paradise lies a treasure trove of underwater wonders that offers a dreamlike experience for all divers. No wonder it has been holding a fifth-year winning streak as Asia's Leading Dive Destination at the World Travel Awards! Whether you are a seasoned or recreational diver, diving into the Philippines' deep blue waters guarantees a visual feast for all.

BICOL

Heading further south, Bicol holds a treasure in the town of Donsol, Sorsogon, renowned for its encounters with whale sharks, locally referred to as "butanding". From November to June, tourists flock to this area for a chance to spot or even swim alongside these gentle giants! Donsol's commitment to sustainable ecotourism practices ensures the well-being of these gentle giants throughout the whale-watching season.

BOHOL

Bohol may be known for its iconic Chocolate Hills but it is also home to a trove of dive sites in the Philippines. Take a plunge into the thrilling wall dives in Panglao, Balicasag, and Cabilao Islands or even spot dolphins near Pamilacan Island. Dive into the deep among sea turtles and even some occasional whales in Bohol's underwater wonders.

BATANGAS

Just a few hours from Manila, Batangas is a haven for macro photography enthusiasts with some of the Philippines' finest dive sites. Anilao, dubbed the "Nudibranch Capital of the World", boasts an array of colorful sea slugs, seahorses, frogfish, and other tiny critters. Nearby towns like Nasugbu, Calatagan, and San Juan also have diverse dive sites that cater to various preferences – be it recreational, muck, or even blackwater diving, all within reach for a weekend getaway from the country's capital.

CEBU

Cebu presents an array of dive sites perfect for beginners and seasoned divers. Moalboal stands out for its famous Pescador Island where one can experience the world-renowned sardine run, while Malapascua Island is a gem for those in search of thresher shark encounters. These incredible sea creatures, along with abundant reefs and diverse fish species, continue to attract divers all year round.

PALAWAN

The paradisical island of Palawan holds as much wonder above water as it does below. Its pristine waters are brimming with vibrant coral reefs and an array of marine life, including reef fish, turtles, sharks, and even whales. The shipwrecks in Coron offer historical immersion amid unique underwater exploration. And you surely wouldn't want to miss the UNESCO World Heritage Site of Tubbataha Reefs Natural Park, where an impressive biodiversity of about 700 species of fish and marine mammals and 360 species of corals are on full display.

TRAVEL PH

SCAN TO ENJOY THE PHILIPPINE EXPERIENCE

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LOVE THE PHILIPPINES

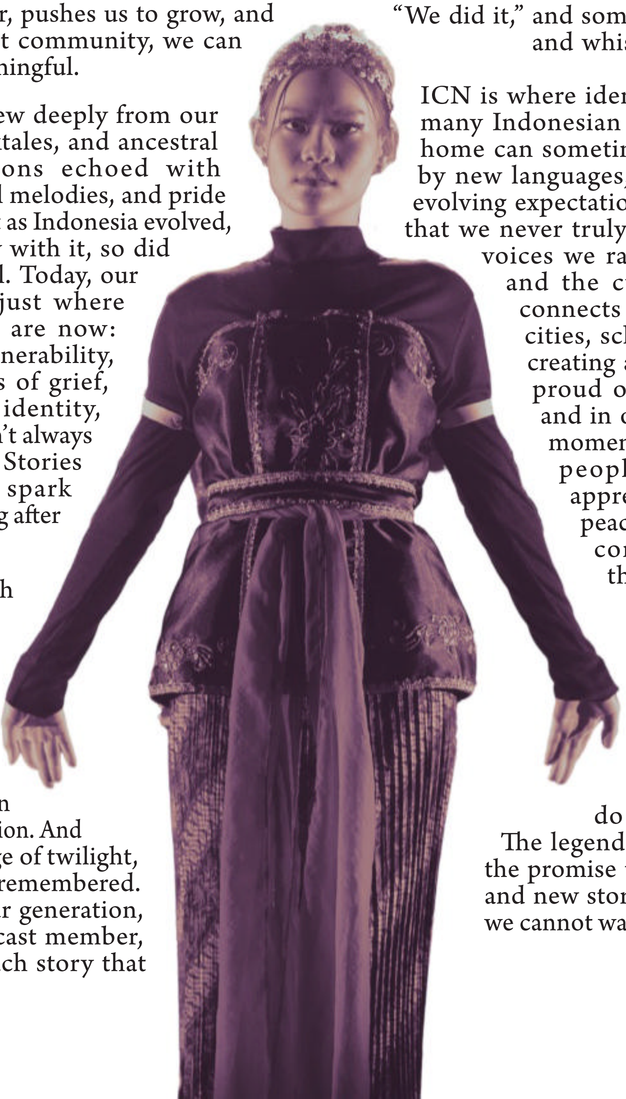
A Journey Through Culture

www.icnmusical.com icnmusical icn.musical

Most people see Indonesian Culture Night (ICN) Cultural Production as just another university musical. But to us, the students who build it, it's so much more. It began in 2007 with nothing more than a spark of ambition: a dream shared by a handful of Indonesian students at Nanyang Technological University (NTU) Singapore. No big budget. No professional crew. Just heart, ambition, and a belief that stories rooted in home deserved a stage. That belief became a movement, one that brings people together, pushes us to grow, and reminds us that with right community, we can build something truly meaningful.

In its early years, ICN drew deeply from our cultural roots, myths, folktales, and ancestral wisdom. Our productions echoed with traditional dances, classical melodies, and pride in where we came from. But as Indonesia evolved, and as we, its youth, grew with it, so did the stories we chose to tell. Today, our productions reflect not just where we're from, but who we are now: shaped by experience, vulnerability, and voice. We tell stories of grief, burnout, mental health, identity, and legacy themes that aren't always loud, but are always real. Stories that challenge silence, spark conversation, and linger long after the lights go down.

Each year, ICN evolves with us. In 2013, we spoke of prophecies and ancestral burdens. In 2018, we explored love and sacrifice. In 2023, we slowed down to reflect on healing. In 2024, we delved into the struggles of young artists torn between passion and expectation. And in 2025, we stood at theedge of twilight, asking what it means to be remembered. These are reflections of our generation, woven with care by each cast member, each crewmember, and each story that adds to the growing legacy.



What makes ICN special isn't just what's on stage, it's who puts it there. No external production house. No professionals. Just over 100 NTU students pour in their nights, weekends, and holidays into something that may live for one day, but leaves a lasting mark. It's the paint-stained fingers after exam week. The rehearsals after lectures. The spreadsheets, the tech runs, the nerves backstage. All building up to that one moment when we, the crew, finally say, "We did it," and someone in the crowd turns and whispers, "This is amazing."

ICN is where identity finds its voice. For many Indonesian students living abroad, home can sometimes feel distant, shaped by new languages, unfamiliar places, and evolving expectations. But ICN reminds us that we never truly left. Home lives in the voices we raise, the stories we tell, and the culture we celebrate. It connects students from different cities, schools, and walks of life, creating a space where we can be proud of who we are together, and in our own voice. It creates moments of communion where people come together to appreciate art and culture in peace, and where unexpected connections are formed through shared meaning.

That purpose, to build something that unites, uplifts, and speaks, is the why behind it all. It's what fuels us, year after year. Because every time we do this, the spark returns. The legend lives again, and with it, the promise that new voices will rise, and new stories will be told – stories we cannot wait to share with the world.

BY YVES SAMSON LI

ICN

Revisit A Passionate Past

Come watch us:

I4 February 2026

I4:00 | I9:00

Drama Centre Theatre,

National Library Building

Scan to visit our website and follow @icnmusical on Instagram to find out more!

{ EDITOR’S NOTE }

Dr Dave Harasti

◆ ◆ ◆

At the end of 2025, *ASIAN Geographic* is ending its quarter-century run as the region’s leading geographical print magazine, with its award-winning coverage of environmental issues, science, exploration, travel, heritage, arts and culture moving to online platforms in 2026. While this marks the end of an era in terms of regular print issues, you can still look forward to forthcoming special editions of *ASIAN Geographic* magazine in the new year – and beyond.

As one of our final issues, this collector’s edition of *ASIAN Geographic PASSPORT* is devoted to one of the principal components that forms the magazine’s DNA, namely, the ocean. In compiling this issue, we took some of our favourite stories from the pages of *Asian Diver*’s “Big Blue Book”, highlighting just some of the iconic animals that inhabit our oceans – and the best spots to dive with them.

We examine “The Magnificent Seven” species of sea turtles (page 22), three of which are listed as “Endangered” or “Critically Endangered” by the International Union for Conservation of Nature (IUCN). We discover why divers are so enamoured with seahorses (“Unravelling the Seahorse”, page 80) and take an intimate look at the private lives of the pygmy species (“Stories from the Stables”, page 90). And, at the other end of the scale, we meet the biggest fish in the sea, the whale shark (“Cerulean Colossus”, page 100), and learn about some other marine heavyweights, the mobula rays (“Ocean Giants”, page 110).

And what better ambassador for ocean tourism than the humble dolphin on our cover, captured by pro photographer Viktor Lyagushkin? Ultimately, ocean tourism, when managed sustainably, is a vital way to get people invested in the ocean as a natural resource – and motivated to protect it.

Ian Bongso-Seldrup

2025
CELEBRATING 25 YEARS OF BRINGING ASIA TO THE WORLD

ASIAN Geographic is finishing its quarter-century run as Asia's top geographical print magazine at the end of 2025, with its award-winning coverage of environmental issues, science, exploration, travel, heritage, arts and culture moving to online platforms. Our final collector's editions promise the same powerful stories and images readers have come to expect from the region's premier magazine spotlighting the issues that matter across our vast continent.

ASIAN Geographic
COLLECTOR'S EDITION
Ai

ASIA FUTURE TECH & TRAVEL

ASIAN Geographic
No. 168 Issue 1/2025

Asia is poised to lead the future of tech, driven by rapid innovation and government investment in emerging fields like artificial intelligence, robotics, 5G connectivity, and drone technology. Countries like China, Japan, South Korea and Singapore are at the forefront, pioneering advancements in smart cities, autonomous vehicles, and renewable energy. With Asia's growing tech talent and thriving startup ecosystems, the region is becoming a global hub for innovation. This issue explores all the latest tech emerging from the region.

INFOGRAPHIC EDITION
Geographic
asia in data
passport

OCEAN TOURISM

ASIAN Geographic PASSPORT
No. 169 Issue 2/2025

This issue focuses on understanding Asia's marine animals and their role in ocean tourism. It highlights the importance of respecting and conserving marine ecosystems while enjoying activities like diving, snorkelling, and whale watching. Through expert insights and captivating stories, readers learn about the behaviour and habitats of seahorses, dolphins, whales, turtles, mantas, and more. The issue promotes responsible tourism practices that protect these creatures and their environments, encouraging a deeper connection, and commitment, to marine conservation.

COLLECTOR'S EDITION
Geographic
passport
Ocean
TOURISM

ASIA IN DATA

ASIAN Geographic
No. 170 Issue 3/2025

With its rapid economic growth, technological innovation, and cultural influence, Asia is a central player on the global stage, shaping the economic and geopolitical landscape, and leading the way in fields such as electronics, robotics, renewable energy, e-commerce, and entertainment. This issue invites readers to gain a better understanding of the region's dynamic complexity through the visually engaging infographics that have made *ASIAN Geographic* magazine such a compelling source of facts and information for more than a quarter century.

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COST

ASIAN GEO GO!

ASIAN Geographic PASSPORT
No. 171 Issue 4/2025

In our final regular issue of *ASIAN Geographic*, we're rediscovering Asia through its most interesting and unusual travel experiences. As vacations dedicated to wellness become increasingly popular, we look at the best resorts aiming to restore body and mind through traditional Chinese medicine, Ayurveda, yoga, spa treatments, fitness programmes, and more. We pay homage to Asia's longest-running hotels and restaurants, and discover the secrets to their enduring appeal. And we venture to the region's strangest corners to discover Asia's weirdest and wackiest dining options.

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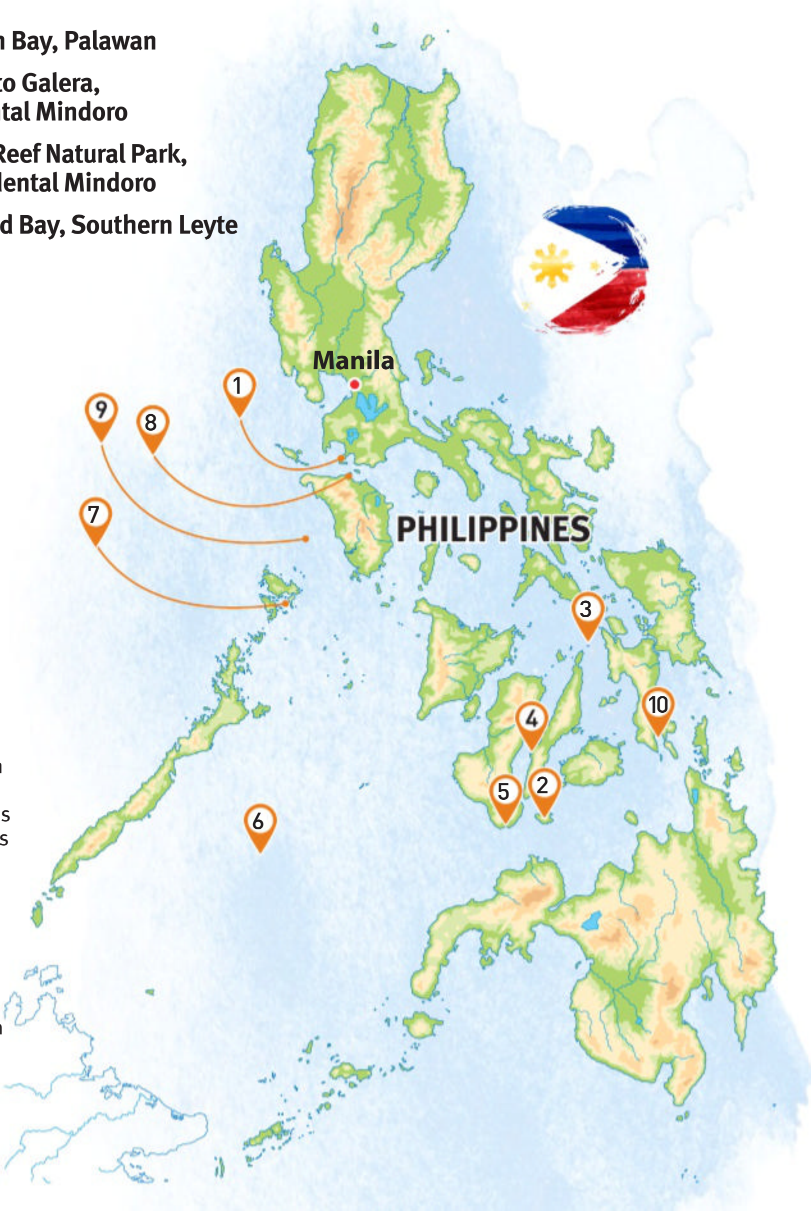
10 Top Diving Experiences in the Philippines

The Philippines is renowned worldwide for its breathtaking marine biodiversity, crystal-clear waters, and vibrant coral reefs. Boasting over 7,000 islands, the archipelago offers countless diving spots that cater to beginners and seasoned divers alike. Whether you're seeking thrilling encounters with sharks, exploring world-class wrecks, or immersing yourself in colourful coral gardens, the Philippines has something extraordinary to offer. Here are 10 of the best diving experiences you should add to your bucket list.

1. **Anilao, Batangas**
2. **Balicasag Island, Bohol**
3. **Malapascua, Cebu**
4. **Moalboal, Cebu**
5. **Dumaguete/Dauin, Negros Oriental**
6. **Tubbataha Reefs Natural Park, Palawan**
7. **Coron Bay, Palawan**
8. **Puerto Galera, Oriental Mindoro**
9. **Apo Reef Natural Park, Occidental Mindoro**
10. **Sogod Bay, Southern Leyte**



EXPEDITION INFORMATION

HOW
Philippines Airlines services Manila's Ninoy Aquino International Airport daily across more than 40 international routes throughout Asia Pacific, Europe, the Middle East, and North America, with domestic connections to its various islands.

WHEN
The best time to discover the Philippines is during the dry season (December to April). However, a visit during the southeast monsoon season (June to October) shouldn't be disregarded, since the rain can be extremely unpredictable. During the southeast monsoon season, you may well experience clear skies and good visibility underwater, and popular dive sites will certainly be much less busy.

INFORMATION
For a great source of information about visiting the Philippines, check out *www.philippines.travel*.

▸▴ At Malapascua, off the northermost tip of Cebu Island, a huge school of sardines engulfs an underwater photographer

▸▾ Moorish idols school on the reef at Tubbataha Reefs Natural Park, 150 kilometres off the coast of Palawan

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1 ANILAO, BATANGAS

The location of the country's first dive centre in 1960s, Anilao is considered the birthplace of Philippine diving. Its proximity to Manila and its rich underwater biodiversity make it a favourite among locals and visitors alike. Anilao is renowned for its macro photography opportunities, with an abundance of tiny critters, including nudibranchs, seahorses, and octopuses. The area features a vibrant reef system that supports a wide array of marine life, making every dive a feast for the eyes.

HIGHLIGHTS

- Mostly calm waters, ideal for both beginners and advanced divers
- Mantis shrimps, frogfish, and rare nudibranch species
- Famous for blackwater diving – night dives conducted in open water to witness weird and wonderful animals rising from the deep

▼
Anilao boasts healthy, colourful reefs with an abundance of soft corals, sponges, sea whips, and gorgonians

▶
A lionfish hovers over Anilao's vibrant reef, showcasing its striking pattern

▶▼
The peacock mantis shrimp (*Odontodactylus scyllarus*) makes an excellent photographic subject

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◂ Anemonefish are among the hundreds of species found around Bohol's Balicasag Island

▾ A green turtle relaxes on the reef off Balicasag Island

▸ Thresher sharks are the stars of the show at Malapascua Island

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Photo Credit

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2 BALICASAG ISLAND, BOHOL

Situated off the coast of Bohol, Balicasag Island is a premier diving destination known for its coral walls and abundant fish populations. Balicasag boasts some of the clearest waters in the Philippines, with visibility often exceeding 25 metres. Its rich coral gardens and wall dives provide an immersive experience that showcases the vibrant marine ecosystems of the region.

HIGHLIGHTS

- The Balicasag Marine Sanctuary offers a protected environment that emphasises conservation and sustainable tourism
- Stronger currents attract pelagics, promising fantastic encounters
- Schools of jacks and barracudas, sea turtles, and occasional reef sharks

3 MALAPASCUA, CEBU

Famous worldwide for its thresher sharks, Malapascua Island is a must-visit for serious divers and wide-angle underwater photographers. The nearby Monad Shoal and Kemod Shoal are among the few places in the world where you can reliably see thresher sharks during their daily cleaning rituals. The island also offers pristine coral reefs and diverse macro life.

HIGHLIGHTS

- Currents are moderate and suitable for all levels
- Thresher and hammerhead sharks, mantas and stingrays, and small critters like seahorses and ghost pipefish
- Nearby Gato Island is known for its swim-throughs, sea snakes, and macro life

4 MOALBOAL, CEBU

Famed for its astonishing sardine run and stunning reef walls, Moalboal offers one of the most exhilarating underwater experiences in the Philippines. The sardine run near Pescador Island draws divers from all over the world, as millions of sardines form swirling, hypnotic schools. It's a spectacle that's hard to match!

HIGHLIGHTS

- Calm waters with excellent visibility
- Sardines, turtles, reef sharks, hammerhead sharks, and octopuses
- Pescador Island's walls are packed with soft corals, sponges, and macro wonders

▶ The mesmerising sardine schools are Pescador Island's big draw

▼ Whale sharks are not infrequent visitors to Moalboal's waters

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5 DUMAGUETE/DAUIN, NEGROS ORIENTAL

A half hour drive apart, Dumaguete and Dauin are renowned for their rich marine diversity. The sanctuaries that line the coastline are home to an incredible array of critters loved by macro enthusiasts, with nudibranchs, frogfish, gobies and anemone shrimp hiding among the coral.

HIGHLIGHTS

- Generally calm diving conditions with good visibility
- Reef fish species such as triggerfish, parrotfish, Moorish idols, pufferfish, filefish, emperors, wrasses, and fusiliers
- Wreck dives and night dives revealing bioluminescent marine life

▼◄ Clowning around in Dumaguete: Photographing Nemo never gets old!

▼ Bubble coral shrimp hang out on their namesake home

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6 TUBBATAHA REEFS NATURAL PARK, PALAWAN

Designated a UNESCO World Heritage Site, Tubbataha Reefs Natural Park is often considered the crown jewel of Philippine diving. Situated in the middle of the Sulu Sea, approximately 275 kilometres south of Puerto Princesa, it is a true wilderness in the ocean. Tubbataha offers pristine coral atolls, vertical walls, deep lagoons, and abundant marine life, its remote location meaning fewer human impacts and healthier ecosystems.

HIGHLIGHTS

- Spectacular coral formations, including massive table corals and gorgonians
- Huge schools of jacks, mackerel, and tunas, along with sharks, manta rays, and whale sharks
- Thrilling drift dives along walls that drop hundreds of metres into the deep

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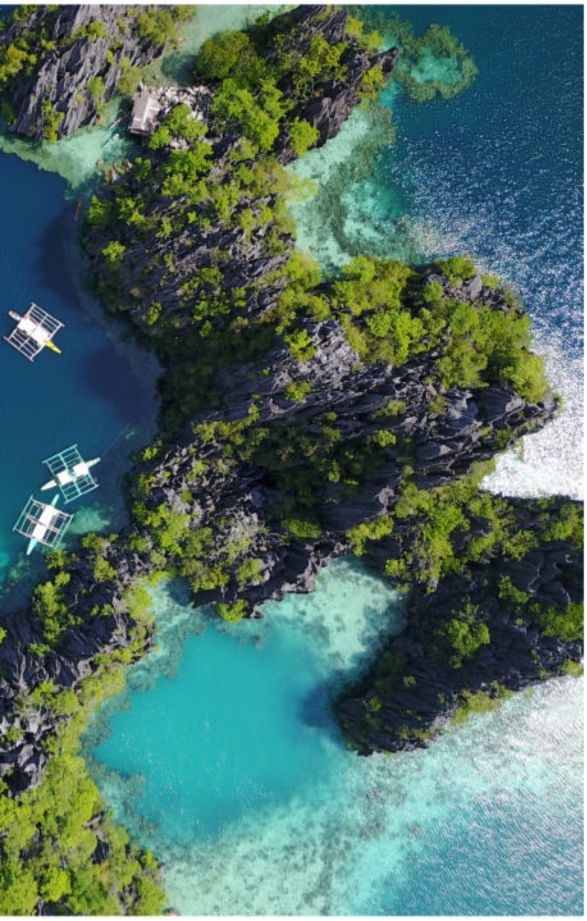


7 CORON BAY, PALAWAN

Just north of Busuanga Island, Coron Bay is famous for its dramatic wreck dives, crystal-clear waters, and lush coral reefs. It remains one of the most popular diving destinations in Palawan. Coron's claim to fame is its World War II wrecks and its vibrant coral gardens. It's a must-visit for wreck enthusiasts and lovers of macro marine life.

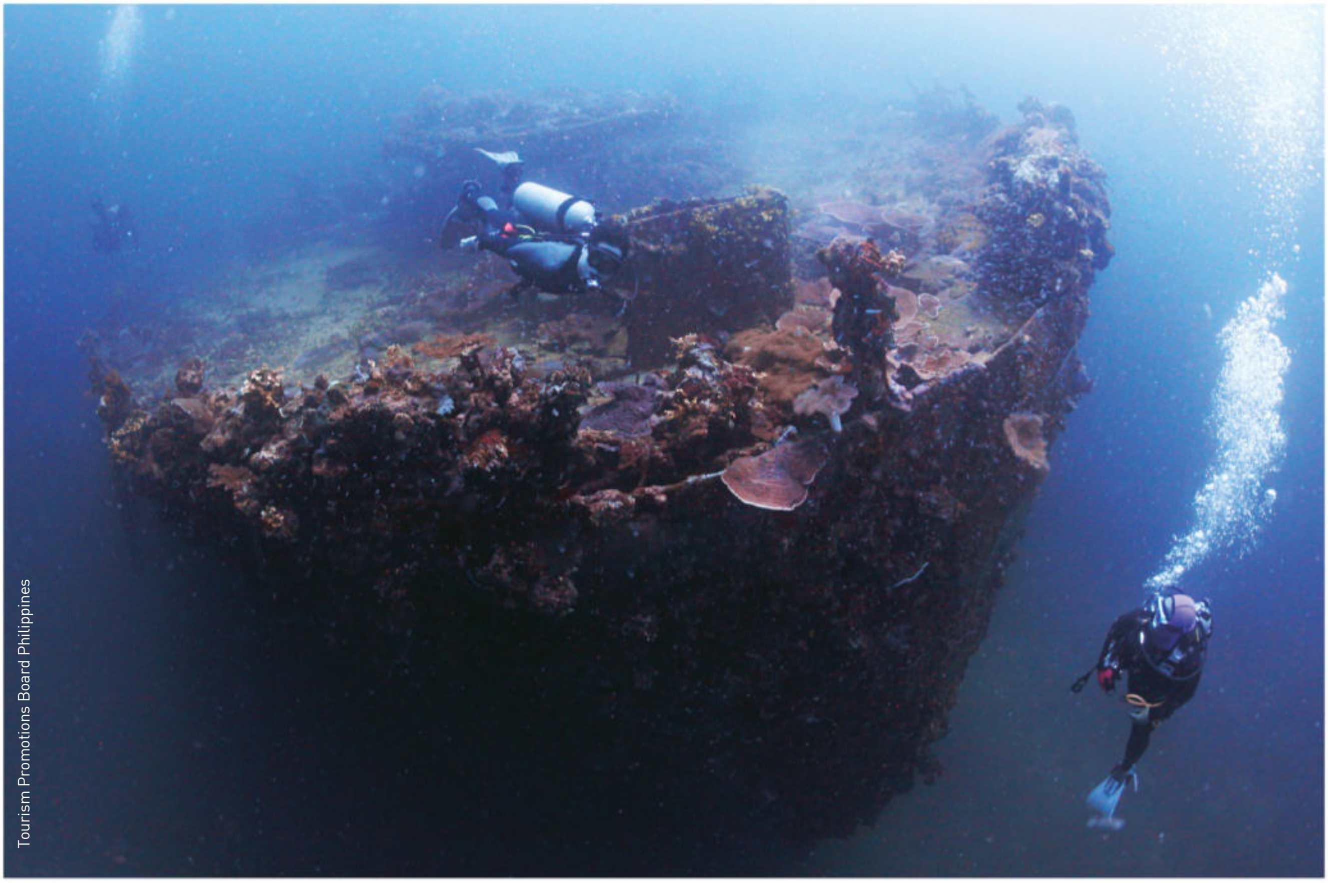
HIGHLIGHTS

- More than a dozen wrecks lie at diveable depths between 5 and 40 metres deep
- Colourful soft and hard corals with abundant marine biodiversity, from lionfish to anglerfish to pygmy seahorses
- Incredible turquoise waters, underwater caves, and lagoons inland

◄ Coron Bay is as stunning above the waterline as it is below

▼◄ The ocean's biggest fish cruises Tubbataha's waters

▼ A diver inspects a coral-encrusted World War II wreck in Coron Bay



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8 PUERTO GALERA, ORIENTAL MINDORO

Located on the northern coast of Mindoro, Puerto Galera is famed for its rich marine biodiversity, including abundant hard and soft corals, as well as hundreds of fish species. The area encompasses the Verde Island Passage, dubbed the "centre of the centre of marine shorefish biodiversity". Expect hidden passages, rocky formations, and dramatic vertical walls that serve as a foundation for an explosion of diverse coral species.

HIGHLIGHTS

- Encounter vast schools of trevallies and snappers on the one hand, and pygmy seahorses and ghost pipefish on the other
- This is also a muck diving hotspot, a paradise for those looking for rare and unusual critters like peacock mantis shrimps and flamboyant cuttlefish
- Blackwater dives reveal the tiny aliens of the deep, including larval forms of reef fish and crustaceans, and pelagic species like paper nautiluses and comb jellies

▼
The Verde Island Passage offers some of the most spectacular reefscapes anywhere in the Coral Triangle

▶▲
A painted frogfish (*Antennarius pictus*) tries its best to blend in

▶▼
A mouth-brooding cardinalfish poses for a close-up portrait

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9 APO REEF NATURAL PARK, OCCIDENTAL MINDORO

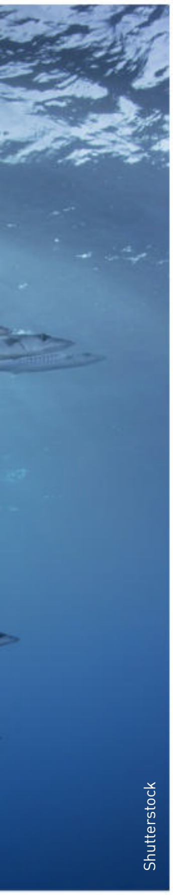
Situated in the Mindoro Strait, Apo Reef is the second-largest contiguous coral reef system in the world – second only to Australia's Great Barrier Reef – and is often called the "Galápagos of Asia". This remote, protected marine park boasts superb coral formations, deep lagoons, and abundant pelagic species. Its pristine condition makes it a top contender for divers seeking epic big-animal encounters.

HIGHLIGHTS

- Clear waters, generally calm, with strong currents that bring in riches from the deep
- Large pelagics like reef sharks, hammerheads, manta rays, barracudas, and giant trevallies
- Beautiful coral gardens with vibrant marine ecosystems

▲ Technicolor corals beckon at the stunning Apo Reef Natural Park

▲▶ At Apo Reef, a small school of chevron barracuda enjoys the gin-clear waters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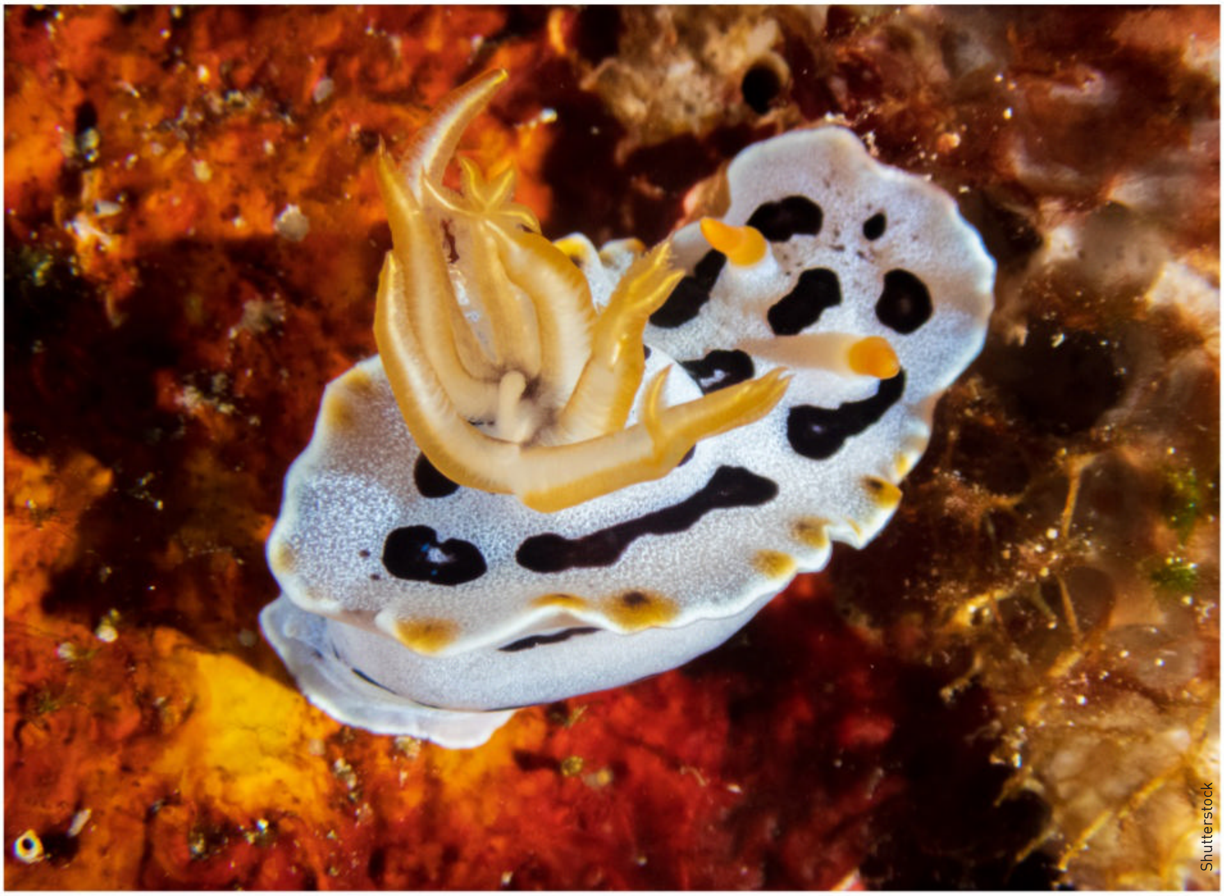
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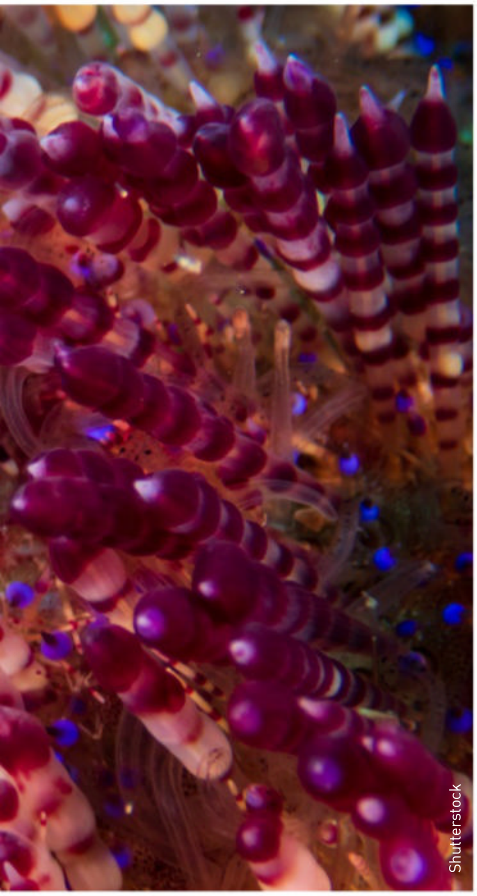
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10 SOGOD BAY, SOUTHERN LEYTE

This pristine bay is one of the Philippines' best-kept secrets. Located in Southern Leyte, Sogod Bay offers unspoiled marine ecosystems with minimal tourist traffic, making it a true haven for eco-conscious divers. Sogod Bay is famous for its big pelagic encounters, especially the chance to see the manta rays and whale sharks that are attracted to the seasonal plankton blooms. Visibility often exceeds 20 metres, revealing a vibrant underwater landscape teeming with life. ◆ AG

HIGHLIGHTS

- Dive sites feature thriving coral reefs, large walls, and seamounts that act as nurseries for diverse marine species
- Macro enthusiasts will love the hidden critters such as nudibranchs, seahorses, and octopuses
- The calm waters and rich biodiversity make Sogod Bay an ideal destination for both casual and advanced divers

▲ With its white body, black spots, and yellow rhinophores, the *Chromodoris orientalis* nudibranch is a sought-after macro subject

◄ At Sogod Bay, a pair of Coleman shrimp (*Periclimenes colemani*) hang out on a fire urchin

TPBPHL
TOURISM PROMOTIONS BOARD PHILIPPINES

The Magnificent Seven

Text by **Serina Rahman**

There are seven marine turtle species worldwide, three of which are listed as "Endangered" or "Critically Endangered". Each have their own habitats, needs and peculiarities, but how much longer will we be able to enjoy their presence on our planet?

David Doubilet

A stack of mating loggerhead turtles in the Florida Keys National Marine Sanctuary, Key Largo, Florida, USA

1. LOGGERHEAD (*Caretta caretta*)

Caretta caretta is classified as “Vulnerable” by the International Union for the Conservation of Nature. It prefers areas around the coast but also tends to swim far upriver to inland water bodies. It can be found worldwide throughout temperate, subtropical and tropical waters.

It is named for its massive head and strong jaws that allow it to prey on its favourite food: molluscs and crustaceans. The loggerhead has a reddish-brown shell that can grow to about one metre and it can weigh up to 150 kilograms. Its shell has more encrusting organisms such as barnacles than any other species.

▼
Loggerheads are found in the Atlantic, Pacific, and Indian Oceans, as well as the Mediterranean Sea

▶
Baby loggerhead sea turtles climb out of their nest and make their way to the ocean

▼▶
A loggerhead sea turtle is released back into the wild

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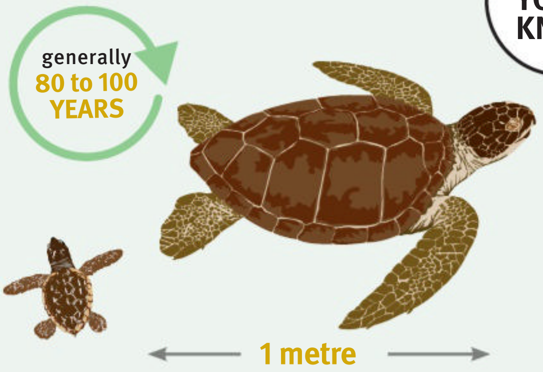
DID YOU KNOW?


generally
80 to 100 YEARS
1 metre

- Loggerheads typically disappear from the time they are hatched until they are about 8 years old

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2. GREEN SEA TURTLE (*Chelonia mydas*)

Chelonia mydas is an endangered species found worldwide throughout the tropics and to some extent in subtropical oceans. It has a dark brown, sometimes mottled heart-shaped carapace that can grow up to 1.5 metres long. Its common name comes from the green colour of its fat that was once used to make soup. Today, many countries ban the import and export of the turtle's meat and eggs.

Green turtles are carnivorous as juveniles, dining on jellyfish, crustaceans and sponges, but they become vegetarian as they get older, eating only seagrass and seaweeds as adults. Weighing up to 200 kilograms, the green turtle can reach an age of about 80 years. In the eastern Pacific Ocean, they tend to stay warm by basking on land – they have been spotted on the beach next to seals and albatrosses and are one of the few species to leave the water for reasons other than nesting.

Beloved by divers, green sea turtles are calm and curious

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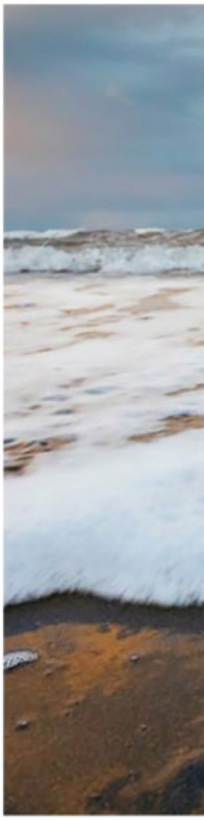


Getty Images

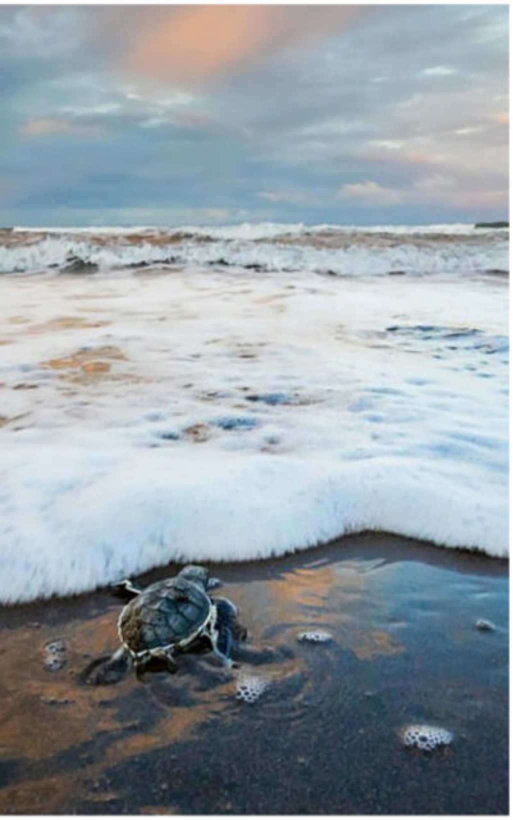
Green turtles are carnivorous as juveniles, dining on jellyfish, crustaceans and sponges, but they become vegetarian as they get older, eating only seagrass and seaweeds as adults.

◄◄
Green turtles love foraging for seagrass in the shallows, as here off Balicasag Island in the Philippines

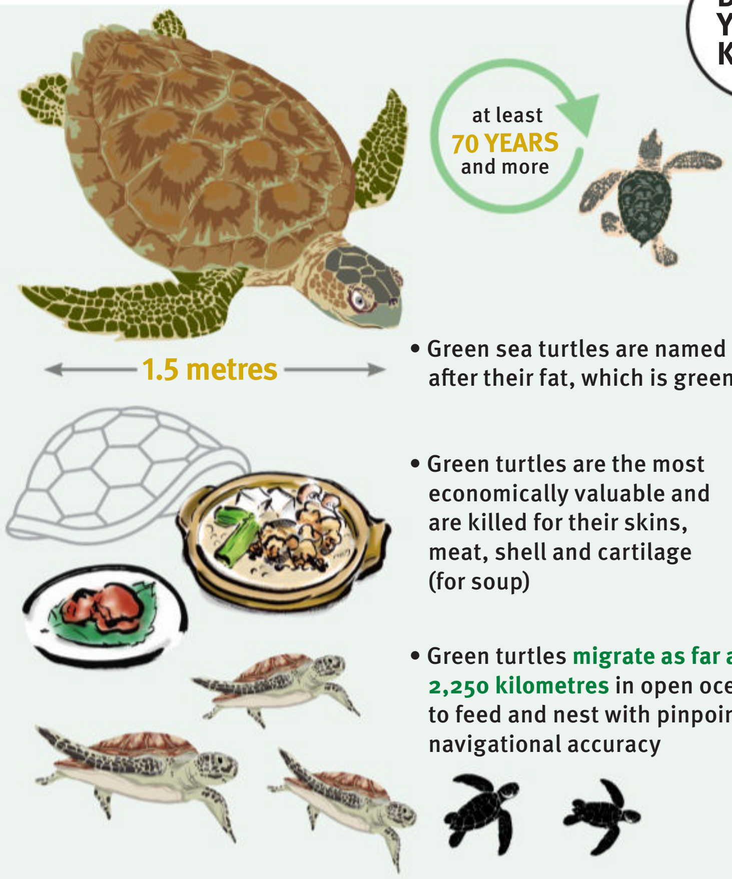
◄
Female green turtles crawl out on beaches, dig nests, and lay eggs during the night

▼◄
Green turtles are generally solitary, but they can form groups at abundant feeding grounds or when migrating

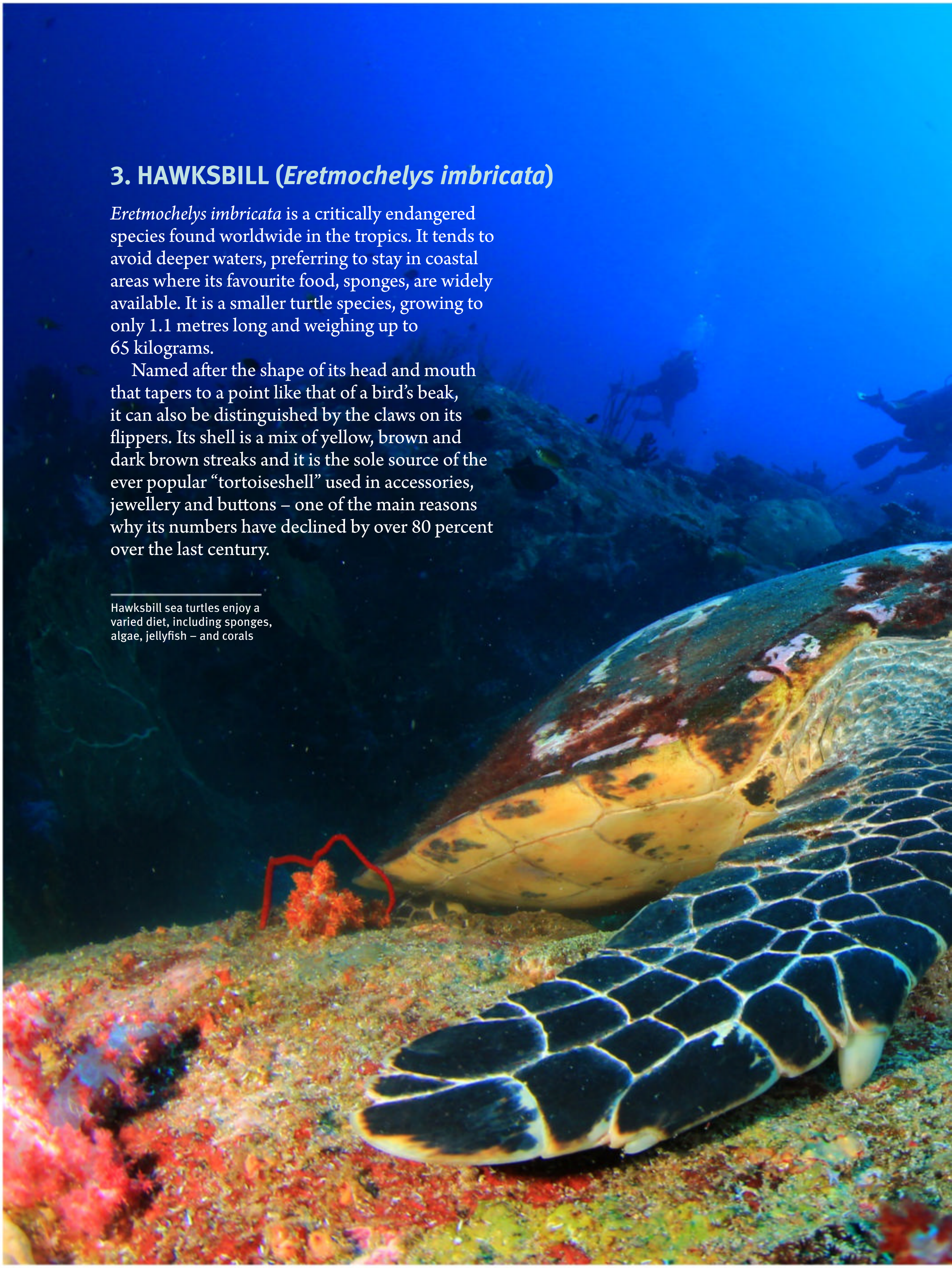
▼►
A green sea turtle hatchling entering the ocean



DID YOU KNOW?



- Green sea turtles are named after their fat, which is green
- Green turtles are the most economically valuable and are killed for their skins, meat, shell and cartilage (for soup)
- Green turtles **migrate as far as 2,250 kilometres** in open ocean to feed and nest with pinpoint navigational accuracy



3. HAWKSBILL (*Eretmochelys imbricata*)

Eretmochelys imbricata is a critically endangered species found worldwide in the tropics. It tends to avoid deeper waters, preferring to stay in coastal areas where its favourite food, sponges, are widely available. It is a smaller turtle species, growing to only 1.1 metres long and weighing up to 65 kilograms.

Named after the shape of its head and mouth that tapers to a point like that of a bird's beak, it can also be distinguished by the claws on its flippers. Its shell is a mix of yellow, brown and dark brown streaks and it is the sole source of the ever popular "tortoiseshell" used in accessories, jewellery and buttons – one of the main reasons why its numbers have declined by over 80 percent over the last century.

Hawksbill sea turtles enjoy a varied diet, including sponges, algae, jellyfish – and corals

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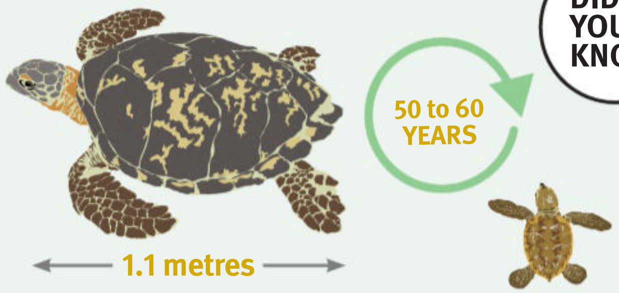
◀▲
Hawksbills are distinguished from other sea turtles by their sharp, curving beak

◀
A hawksbill turtle lays eggs on a beach

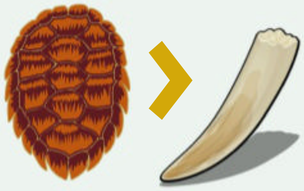
▲
Hawksbill nests typically contain over 100 eggs, and hatchlings emerge after around two months

Named after the shape of its head and mouth that tapers to a point like that of a bird's beak, the hawksbill can also be distinguished by the claws on its flippers.

DID YOU KNOW?



- Young hawksbill turtles have heart-shaped carapaces that elongate as they get older
- Hawksbills are one of the few marine animals that feed on sponges in spite of their tiny glass-like spicules



- Hawksbill tortoiseshell was once as valuable as elephant's ivory

4. KEMP'S RIDLEY (*Lepidochelys kempii*)

Classified by the IUCN as "Critically Endangered", *Lepidochelys kempii* is the world's most endangered turtle. In 1947 a passerby caught footage of about 40,000 turtles coming to shore for a mass nesting event on a single beach in Mexico. Today, the world's total nesting population is about 5,000 females, a significant recovery from their numbers in the 1980s. The Kemp's ridley turtle is the smallest of the marine turtles, with a carapace that grows to only 65 centimetres and a maximum weight of about 45 kilograms. It feeds largely on crustaceans such as crabs, but will also occasionally graze on jellyfish, seaweed and seagrass. It nests only on the east coast of Mexico but is known to migrate as far north as Nova Scotia, Canada.

▼
The Kemp's ridley is one of two species in the genus *Lepidochelys*, the other being the olive ridley

▶
Kemp's ridley baby turtles making their way to the sea after hatching

▼▶
As well as being the smallest and the rarest, the Kemp's ridley is the only sea turtle that nests during the day

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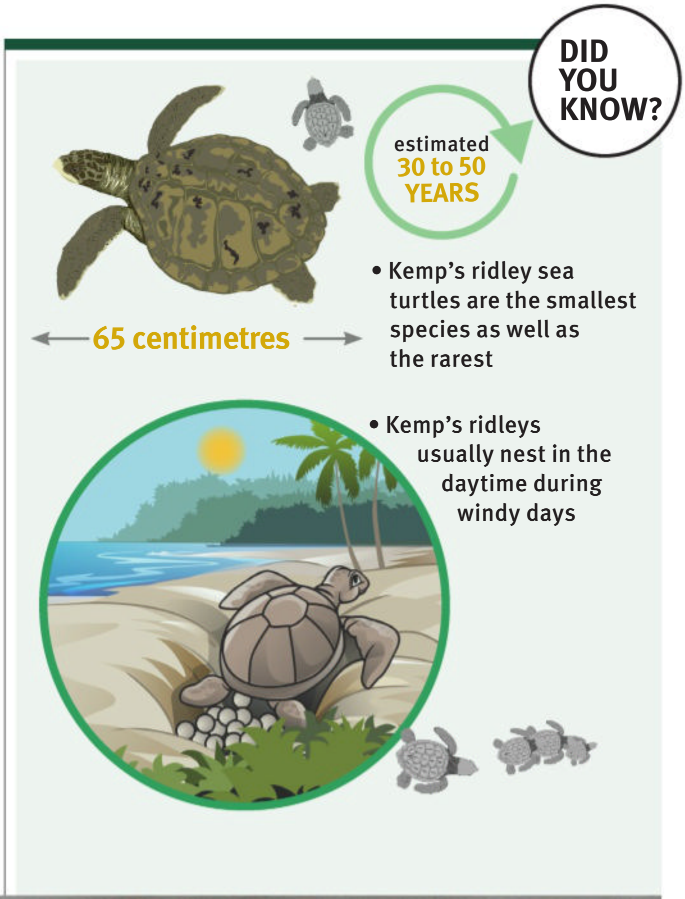
DID YOU KNOW?


estimated
30 to 50
YEARS
65 centimetres

- Kemp's ridley sea turtles are the smallest species as well as the rarest
- Kemp's ridleys usually nest in the daytime during windy days

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▲ As with other reptiles, the ambient temperature of the leatherback's nest determines the sex of the hatchings

5. LEATHERBACK (*Dermochelys coriacea*)

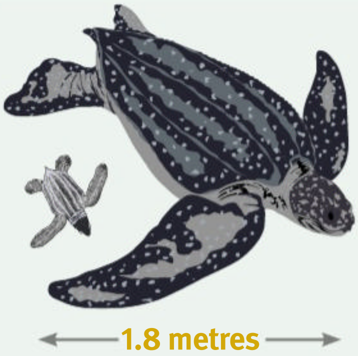
A critically endangered species, *Dermochelys coriacea* is the sole remaining representative of a family that can trace its roots to more than 100 million years. It has the widest distribution of all the turtles and has even been found in Arctic and Antarctic waters. It makes the longest migratory journeys between feeding and breeding sites, with an average distance of 6,000 kilometres. It can also dive the deepest of all turtles – to depths of 1,280 metres – and is able to stay down for up to 85 minutes.

The leatherback has an inky-blue to black shell with white patches and can grow to 1.8 metres. The largest of the marine species, it can weigh up to 500 kilograms, feeding primarily on soft-bodied pelagic animals such as jellyfish and squid. This turtle is in decline largely as a result of habitat destruction and bycatch. In Malaysia, there were about 10,000 nestings a year in the 1950s, but the population has crashed; there are no remaining nesting sites in the country.

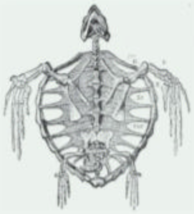
◄▲ Leatherbacks have a carapace covered by flesh and flexible, leather-like skin

◄ Unlike other turtle species, leatherbacks don't always return to their hatching beach

DID YOU KNOW?



50 YEARS or more in the wild



- Leatherbacks are the only marine turtles whose backbone is not attached to the inside of its shell

- Leatherbacks are the sole survivors of a primitive order that is said to resemble the earliest sea turtles

- Leatherbacks are the deepest diving turtles and can dive to 1,280 metres

dive to **1,280** metres

6. OLIVE RIDLEY (*Lepidochelys olivacea*)

Lepidochelys olivacea is listed by the IUCN as a vulnerable species but it is the most abundant of all marine turtle species. In spite of that, it has not yet recovered from centuries of exploitation and some populations are in steep decline as it has very few breeding sites. It is found in warmer waters and is a solitary animal, preferring the open ocean and congregating only for periodic mass nestings on the Pacific coasts of Mexico and Central America, as well as the coasts of India.

This species is closely related to the Kemp's ridley, but it has a smaller head and shell, growing to 70 centimetres and 45 kilograms. It feeds on jellyfish, crustaceans and the odd seaweed.

A pair of olive ridley sea turtles performs a mating ritual

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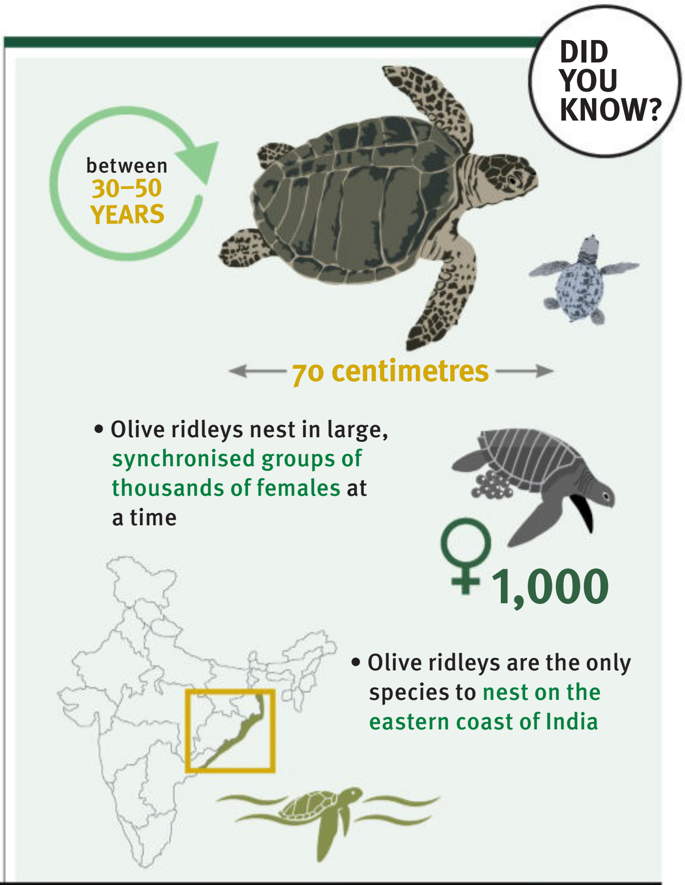
The olive ridley is closely related to the Kemp's ridley, but it has a smaller head and shell, growing to 70 centimetres and 45 kilograms.

◂
While solitary nesting is most prevalent, olive ridley turtles also engage in synchronised mass nesting, termed *arribada* – Spanish for "arrival"

▾
The world's largest olive ridley nesting site is Gahirmatha Marine Sanctuary in the eastern Indian state of Odisha

◂▾
Eggs hatching from the olive ridley sea turtle in a nest of a Costa Rican Pacific beach

DID YOU KNOW?



- Olive ridleys nest in large, synchronised groups of thousands of females at a time
- Olive ridleys are the only species to nest on the eastern coast of India

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7. FLATBACK (*Natator depressus*)

Natator depressus is largely found in northern Australia with small populations in southern parts of Indonesia and Papua New Guinea. Research on this species is still insufficient, placing it in the "data deficient" category by the IUCN. The number of nesting female flatbacks is estimated to be about 10,000 individuals but the life expectancy of the species is still unknown.

Its name is derived from its olive-grey shell, which that is flat on top and has slightly upturned edges. Studies indicate that it prefers shallow, inshore turbid waters and it is known to nest in sheltered, even muddy beaches. It feeds on soft animals such as sea cucumbers, jellyfish and soft corals. ◆ AG

◄◄
A female flatback turtle makes her way back to the ocean after laying her eggs

◄
A tiny flatback sea turtle hatchling at Bare Sand Island, Australia

▼◄
A flatback turtle emerges from the surf to find a safe place to lay her eggs

▼►
A hatchling flatback turtle emerges from the sand at Bells Beach, Australia

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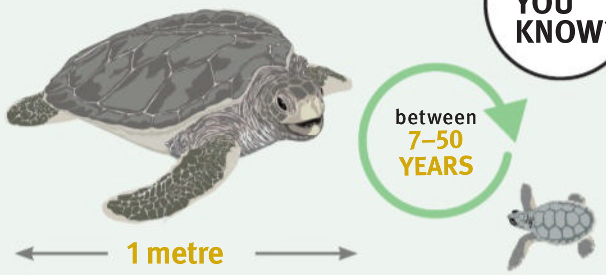
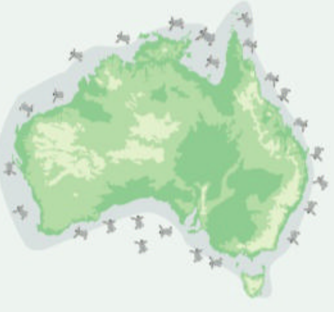
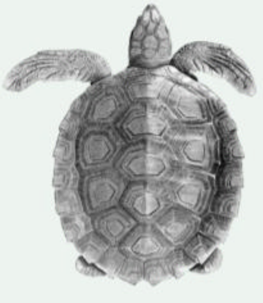
DID YOU KNOW?





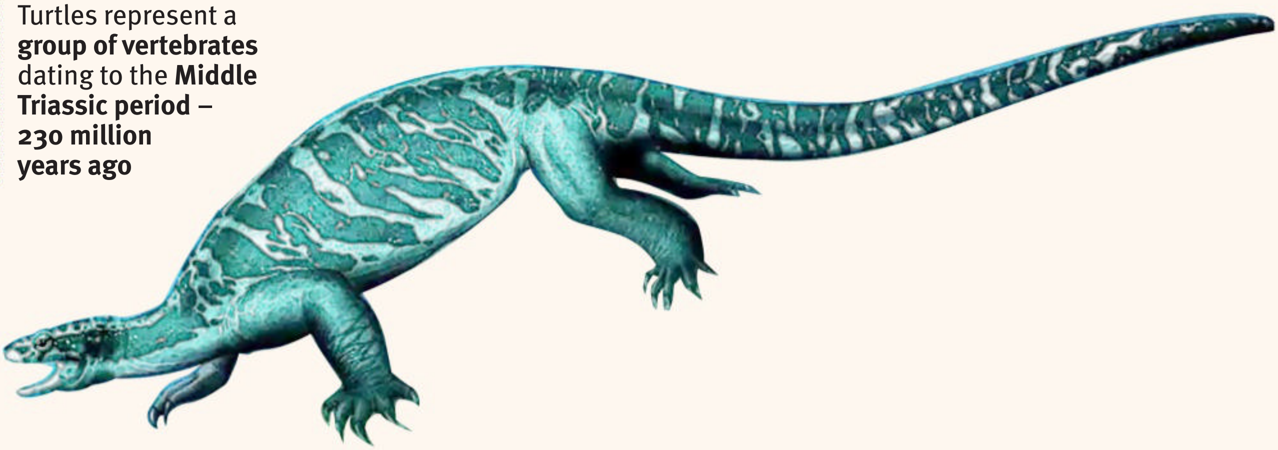
- Flatbacks are the only species that do not migrate to breed and nest; they always stay around Australian coastal waters



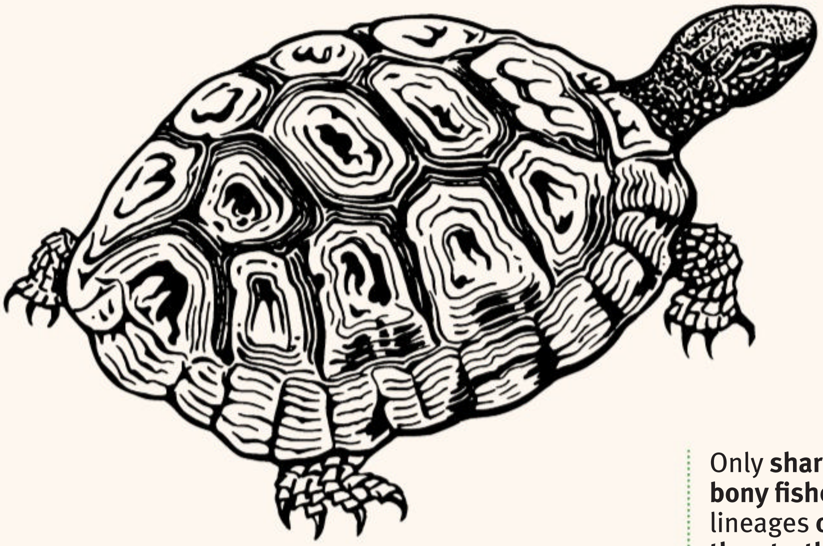
- Flatbacks are named after the smoothness of their shell

Turtles: Fascinating Facts

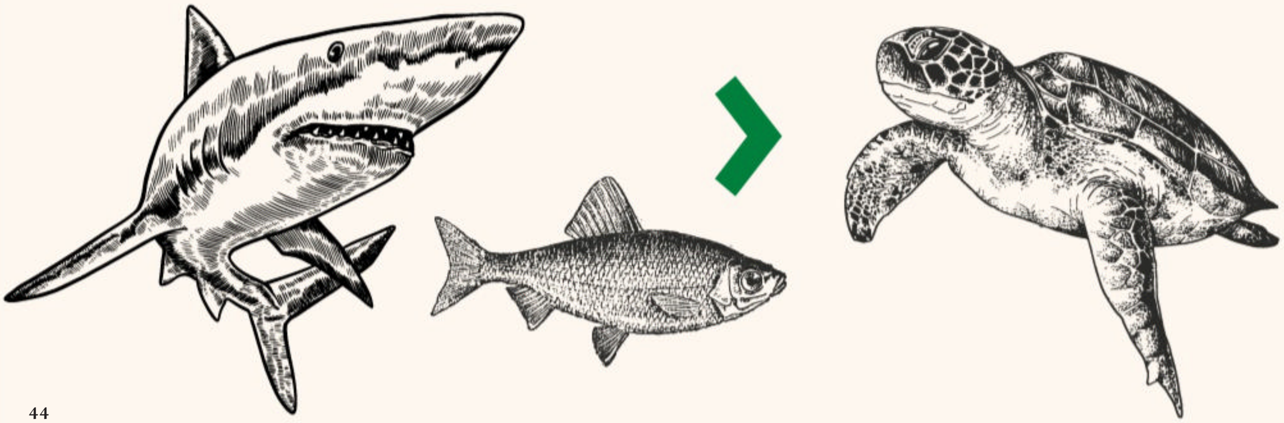
Turtles represent a **group of vertebrates** dating to the **Middle Triassic period – 230 million years ago**

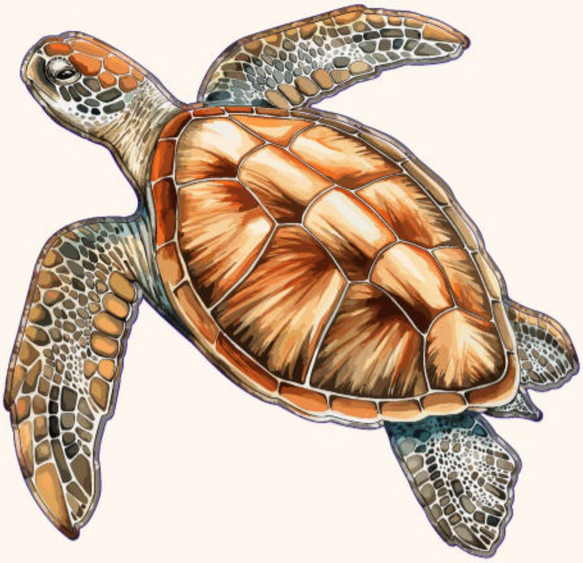


A **turtle's shell** is made of hard bony plates called **scutes** that are made of keratin (as in **fingernails, hooves** and **hair**)



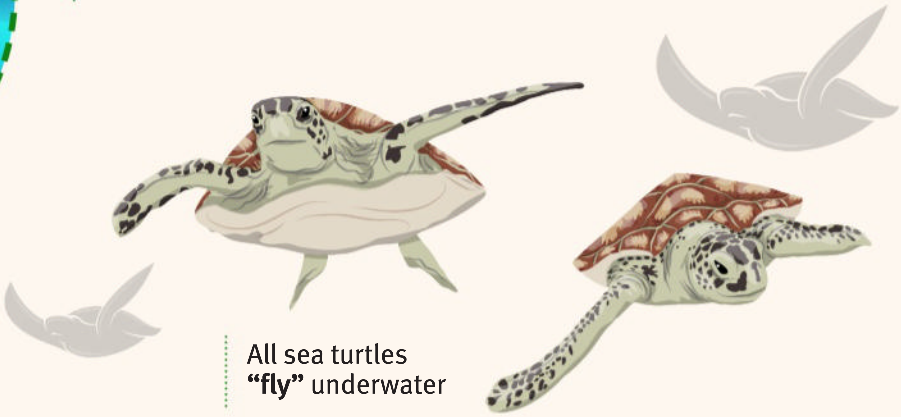
Only **sharks and bony fishes** have lineages **older than turtles**



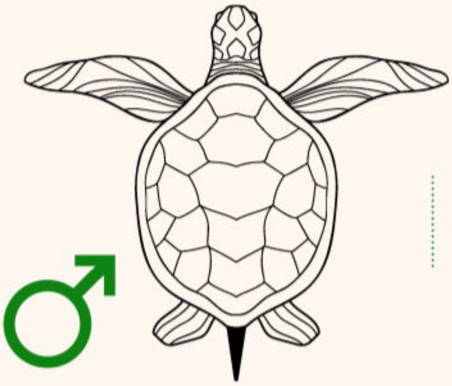


Melanin in a **turtle's scutes** determine the **colour of the shell**

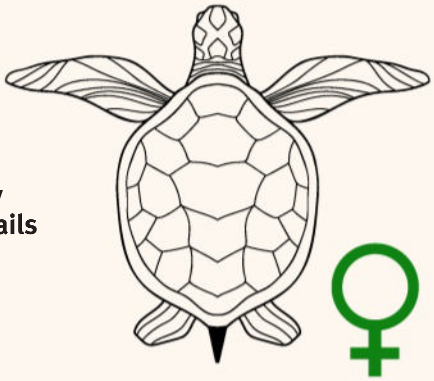
Sea turtles need to **surface** for a **breath every 4 or 5 minutes** but can **sleep** underwater for **several hours**



All sea turtles **"fly"** underwater



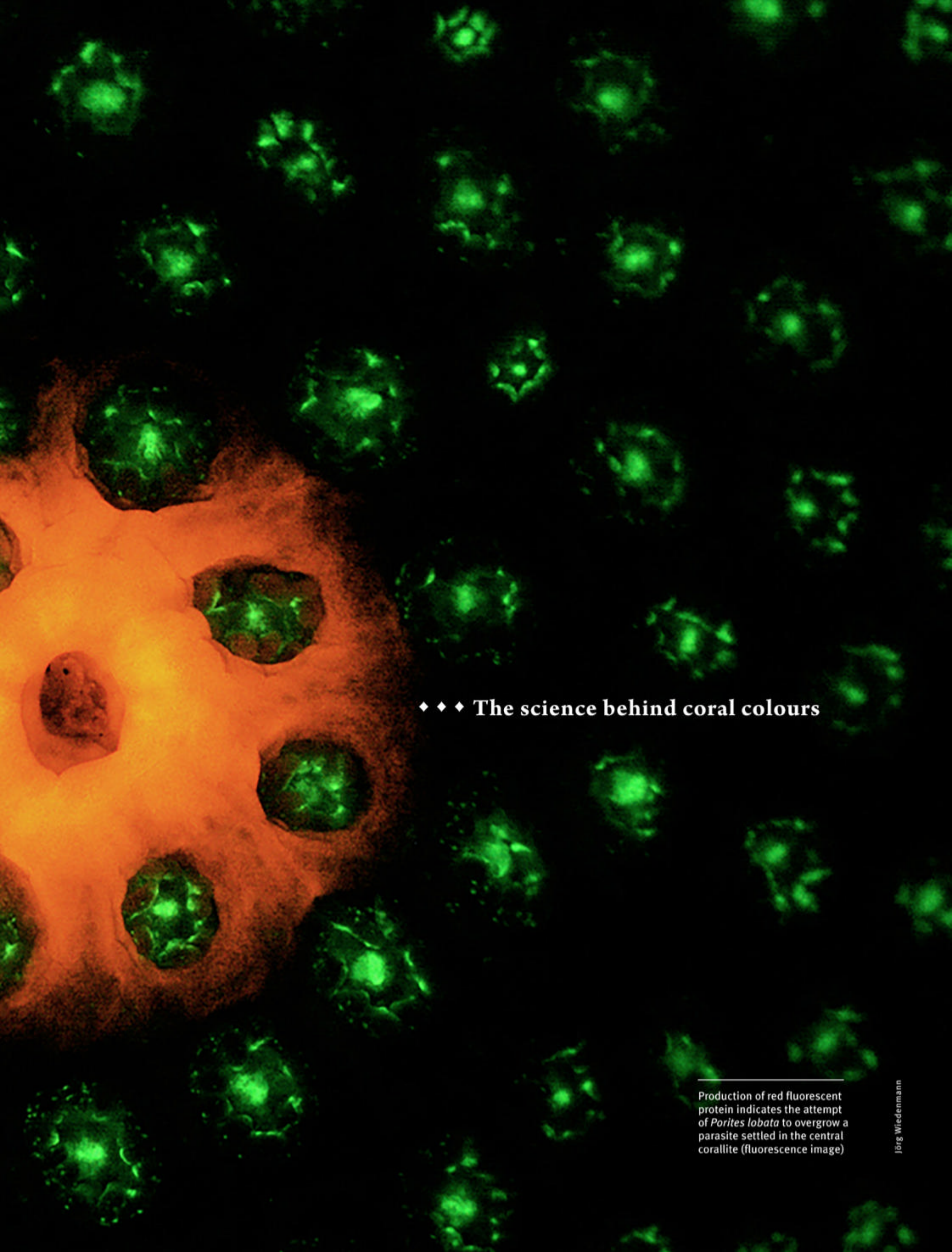
Males usually **have longer tails** than females



Go for the Glow

Text by **Dr Cecilia D'angelo and Prof. Jörg Wiedenmann**

The science behind coral colours



Production of red fluorescent protein indicates the attempt of *Porites lobata* to overgrow a parasite settled in the central corallite (fluorescence image)

Jörg Wiedenmann

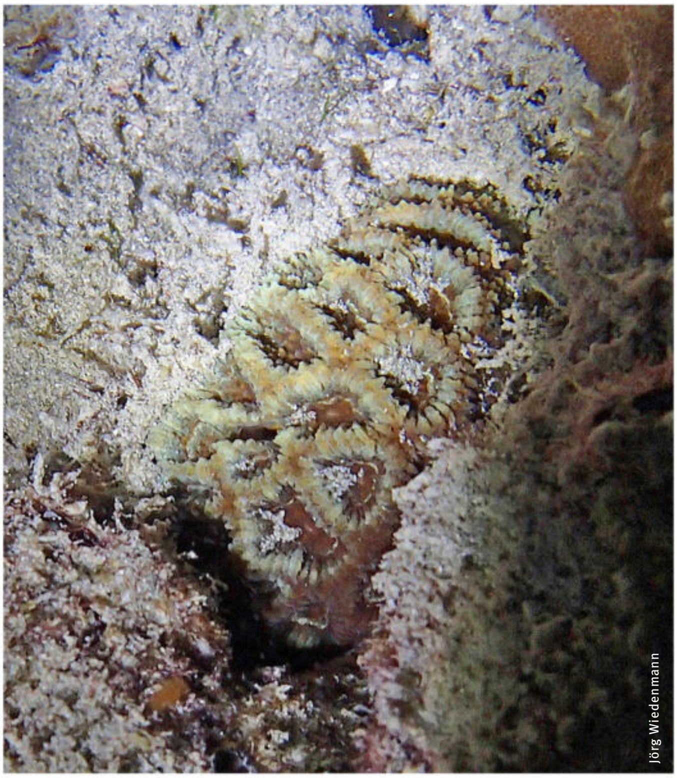
AB Lee

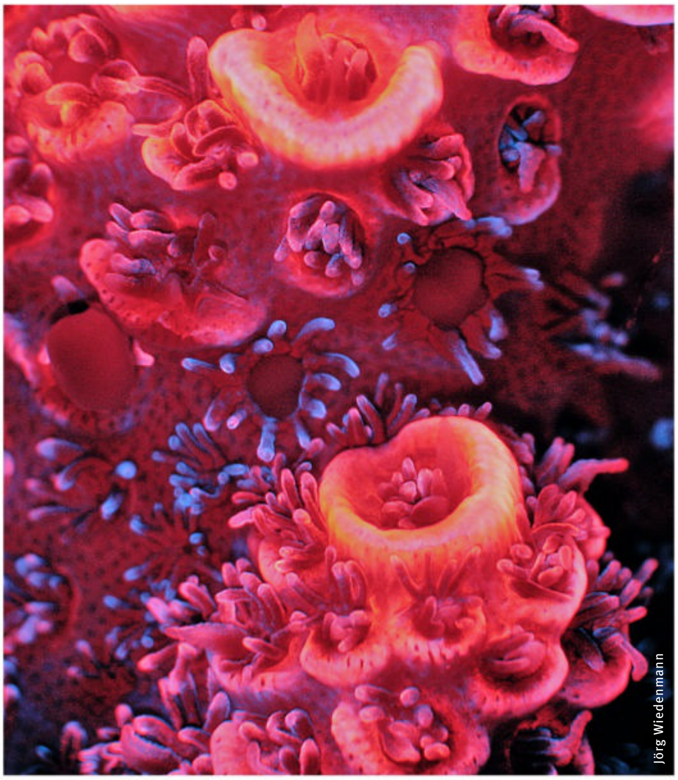
The fluorescent coral pigments are all related to the green fluorescent protein (GFP) from *Aequorea victoria*, which is involved in the bioluminescence reaction of this jellyfish.

▲
A colourful look at Redang's Black Coral Garden, Redang, Malaysia

The stunning colours of corals attract many divers to the reefs of the world. The Indo-Pacific region in particular, a hotspot of coral biodiversity, is home to a large number of species with spectacular colours. While the brownish appearances of some corals under daylight is due to the photosynthetic pigments of the symbiotic algae that live in their tissue, most of the green, red and purple-blue hues are caused by a family of protein pigments.

Some of these pigments glow green or red under ultra-violet or blue light, a physical phenomenon called fluorescence. This is a process during which light of a distinct colour is taken up by certain dye particles and subsequently re-emitted with a different, more red-shifted colour. Everyday examples of fluorescent dyes can be found in marker pens or high visibility clothing. The fluorescent coral pigments are all related to the green fluorescent protein (GFP) from *Aequorea victoria*, which is involved in the bioluminescence reaction of this jellyfish.


Jörg Wiedenmann

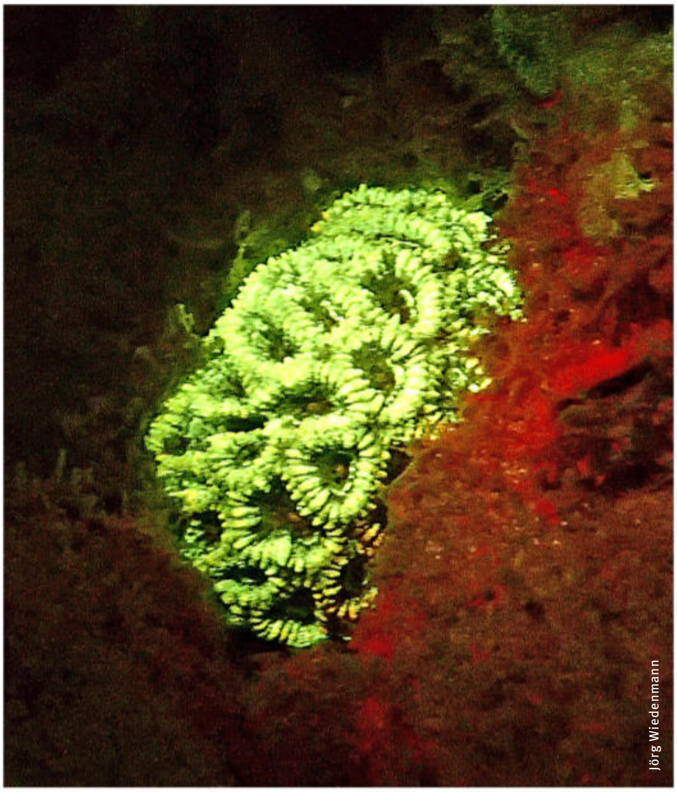

Jörg Wiedenmann

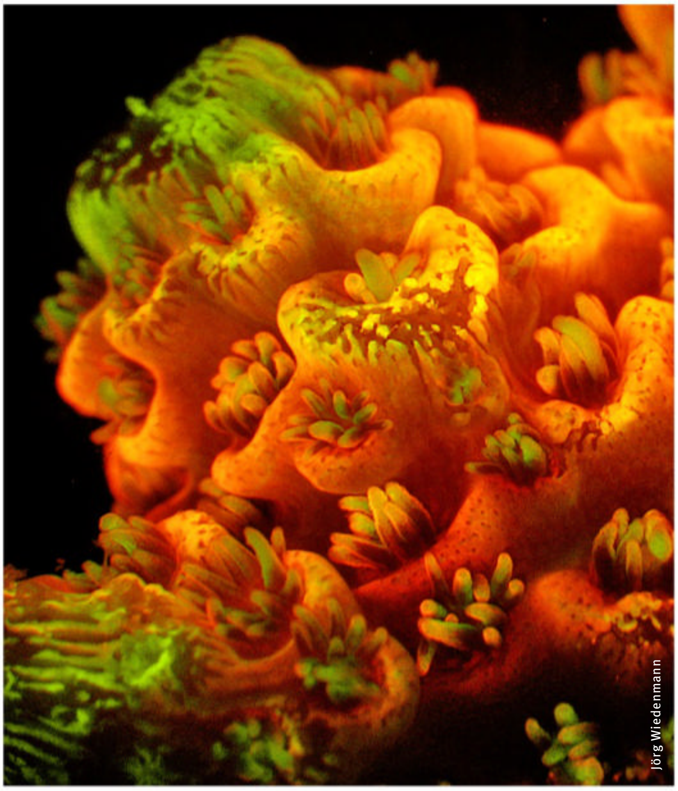
▲
Coral during a night dive viewed with a white light torch

▼
The fluorescence of the same coral when viewed with filter glasses and a blue light torch

▲
Fluorescence of *Acropora* coral

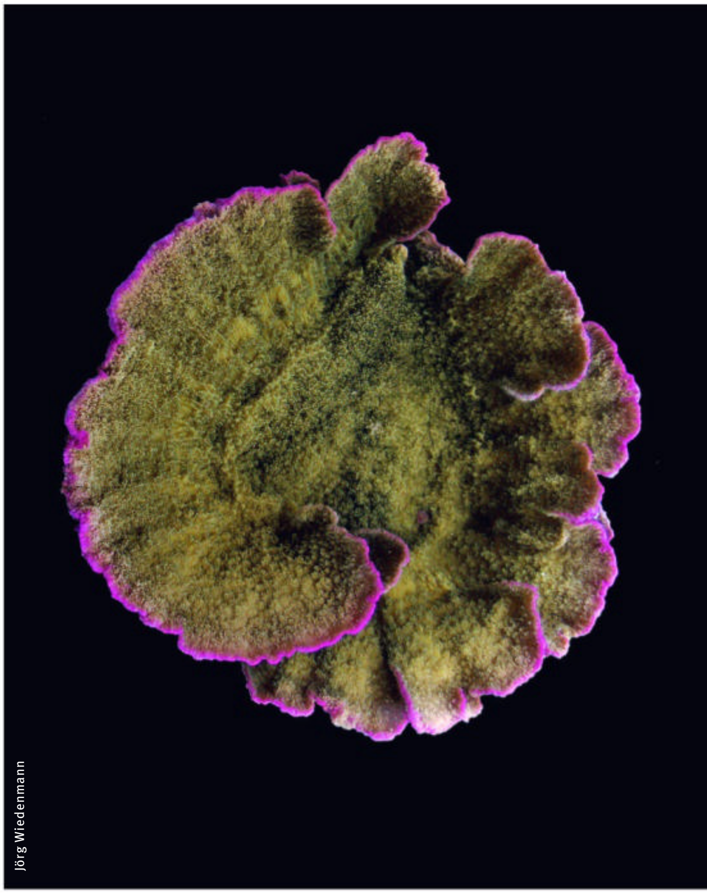
▼
Green and red fluorescence of *Acropora millepora*


Jörg Wiedenmann


Jörg Wiedenmann

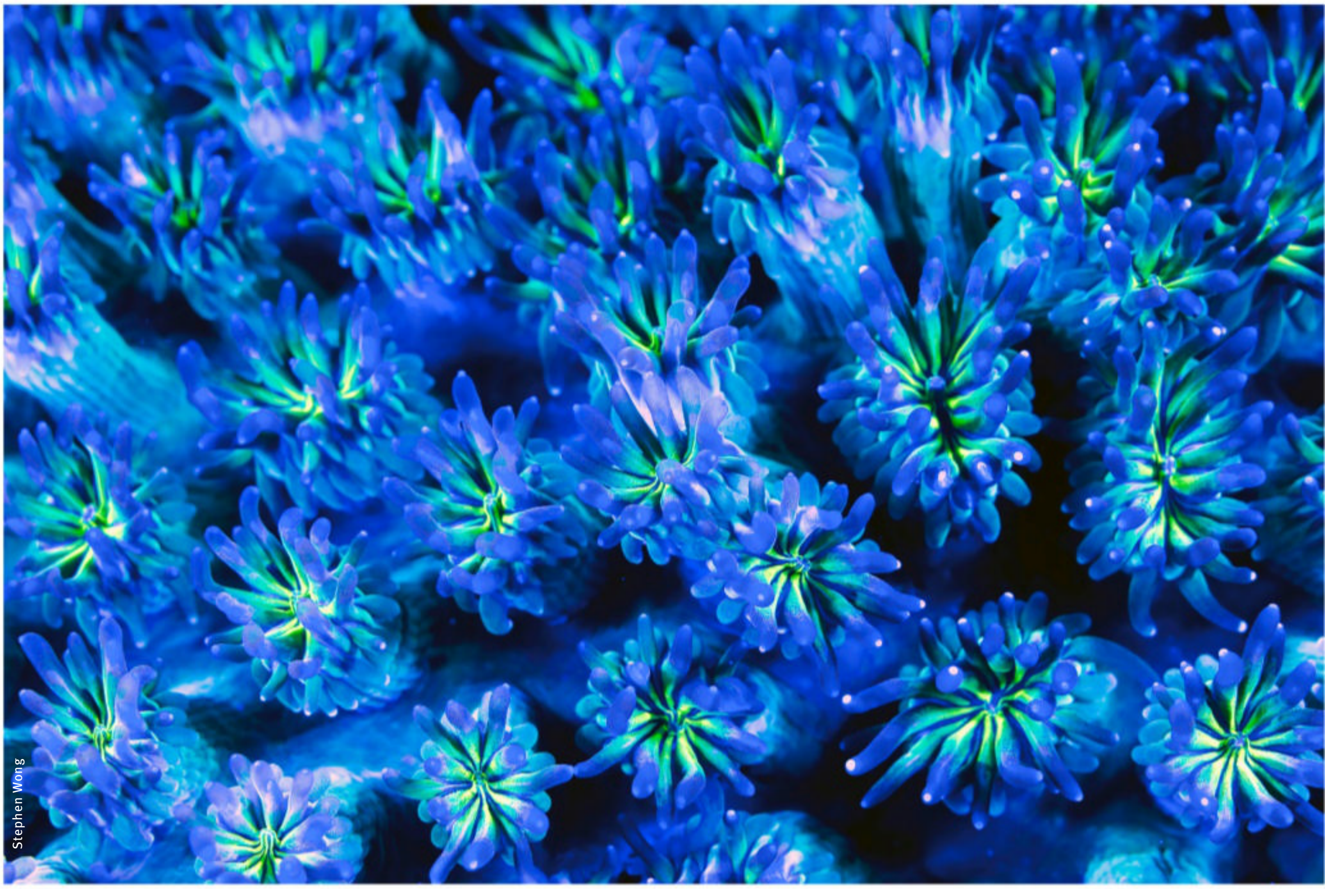
In shallow depths, down to approximately seven metres, it is often the non-fluorescent GFP-variants (chromoproteins) responsible for the pink, purple and blue coral colours that catches the eye of the diver. Going deeper, these colours tend to become dull, since their brilliance depends on the reflection of red light, which is missing in the underwater light field at greater depths.

There, where blue light dominates, the green and red fluorescence of some corals make them stand out from the bluish-grey background. Fluorescence can be best observed with the help of blue light torches and special filter masks under low light conditions. Using this equipment, the glow of the corals will render a night dive a psychedelic adventure.



▶ *Montipora foliosa* expressing purple chromoproteins in the growth margins (daylight image)

Jörg Wiedenmann



▼ Coral fluorescence: the electric blue of the *Galaxea* coral at Manado, Indonesia

Stephen Wong

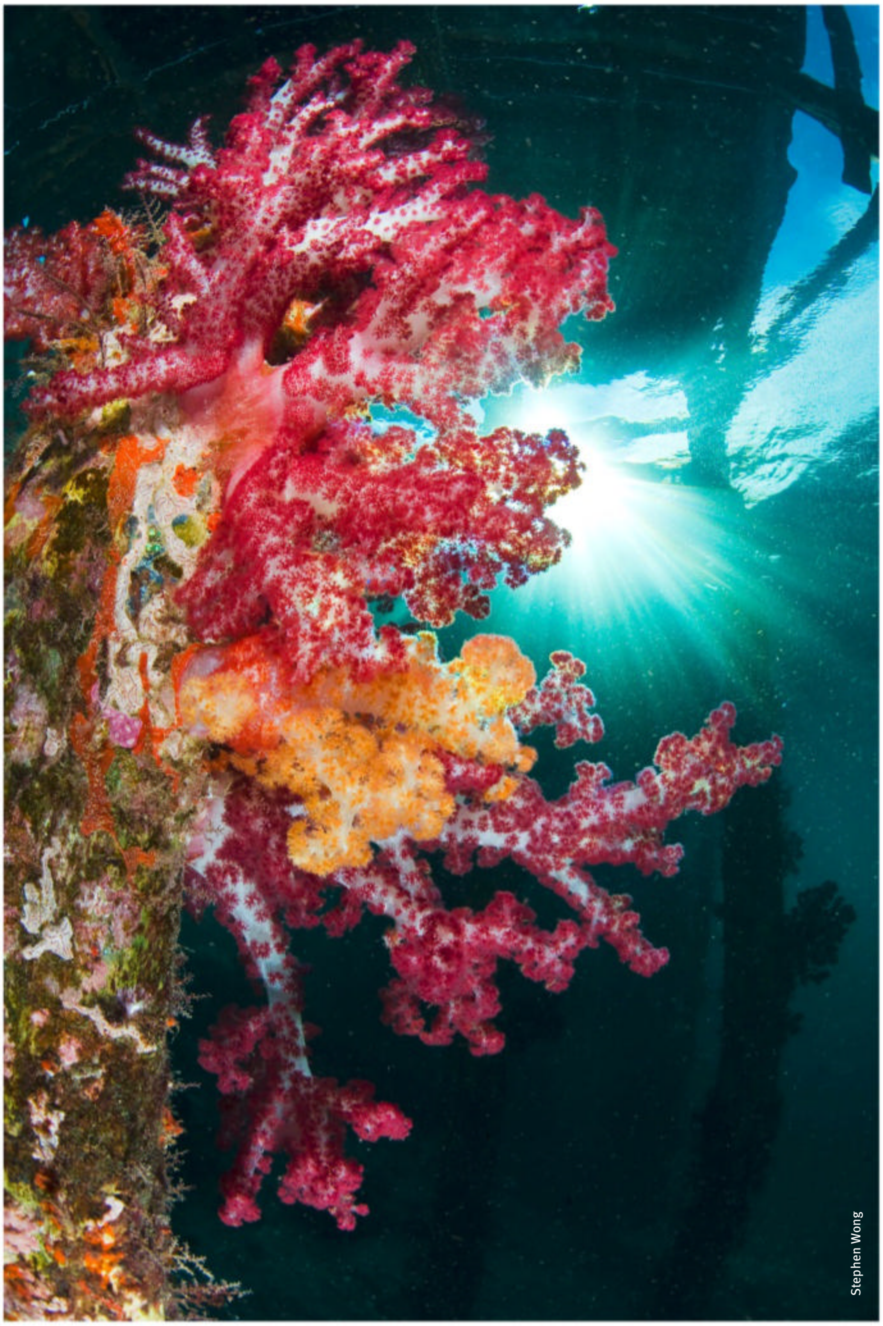
Jörg Wiedenmann

Cabbage patch: The colours of Papua New Guinea with *Ellisella elongata* (sea whips) and *Sinularia dura* at the Honeymoon dive site

Interestingly, the fluorescent proteins of corals and other marine creatures are widely used in biomedical research and the pharmaceutical industry. Their glow can be used, for instance, to study malignant processes in cancer cells. The impact of this technology is considered so high, the 2008 Nobel Prize in Chemistry was awarded to the scientists who discovered and developed the first green fluorescent protein that was applied as a cellular marker.

Among other projects running at the Coral Reef Laboratory of the University of Southampton, we study the mechanisms of how corals become colourful and why the display of this rainbow of colours. Some corals increase the production of the colourful pigments from the green fluorescent protein family when they are exposed to more intense sunlight. Humans get a sun tan – corals become more colourful!

Some corals increase the production of the colourful pigments from the green fluorescent protein family when they are exposed to more intense sunlight.



Stephen Wong

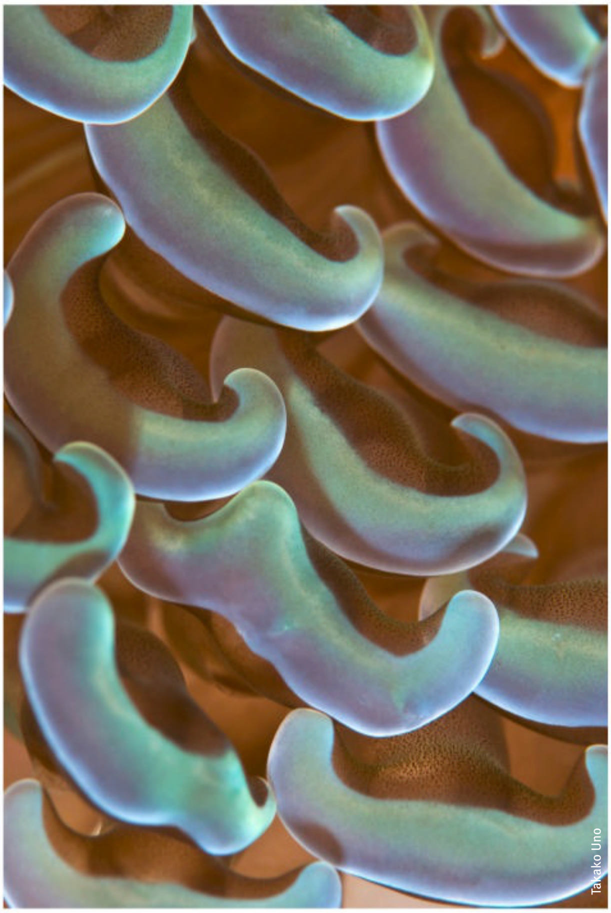
▸
Dendronephthya sp. at Aerborek Jetty, Waigeo, Raja Ampat, Indonesia

▸▸▴
Platygyra lamelllina (brain coral) at Tatawar Besar, Komodo, Indonesia

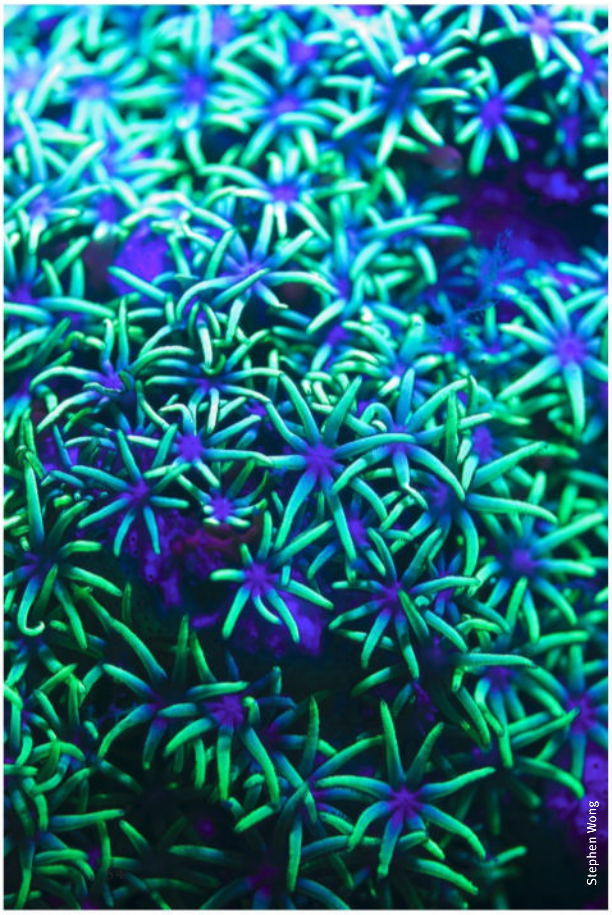
▸▸▾
Detail of the *Turbinaria* coral, Lembeh, Indonesia

Stephen Wong

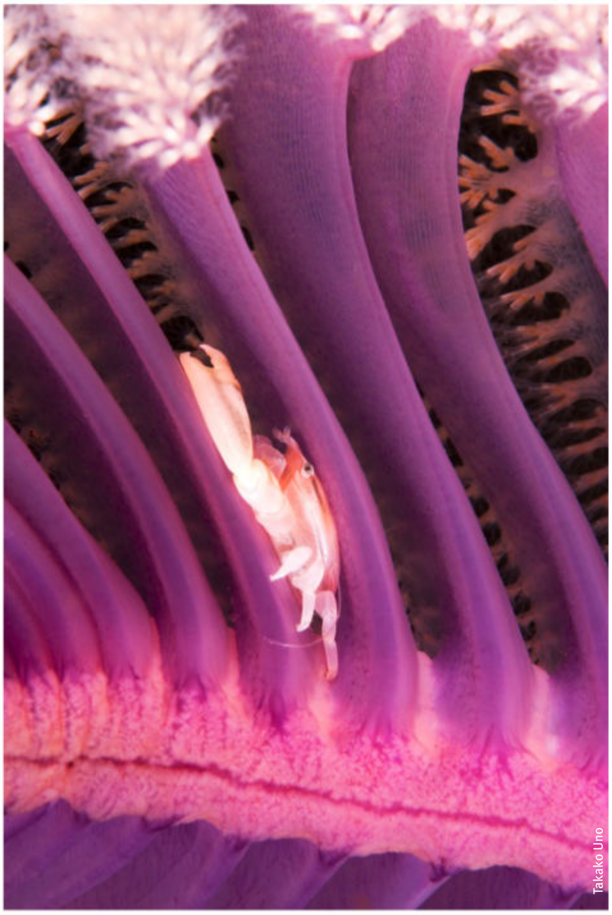
Takako Uno


Takako Uno

Takako Uno


Stephen Wong

Stephen Wong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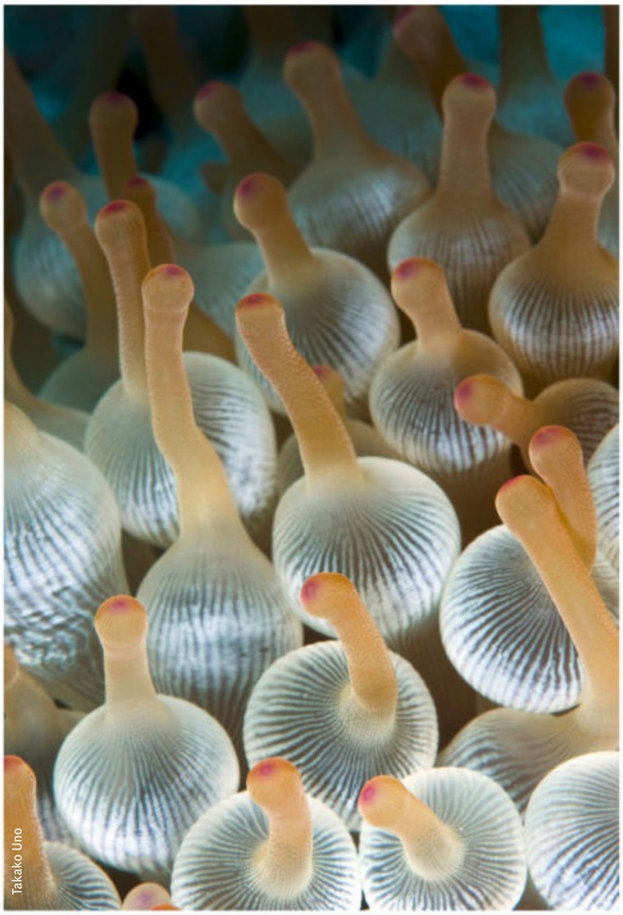
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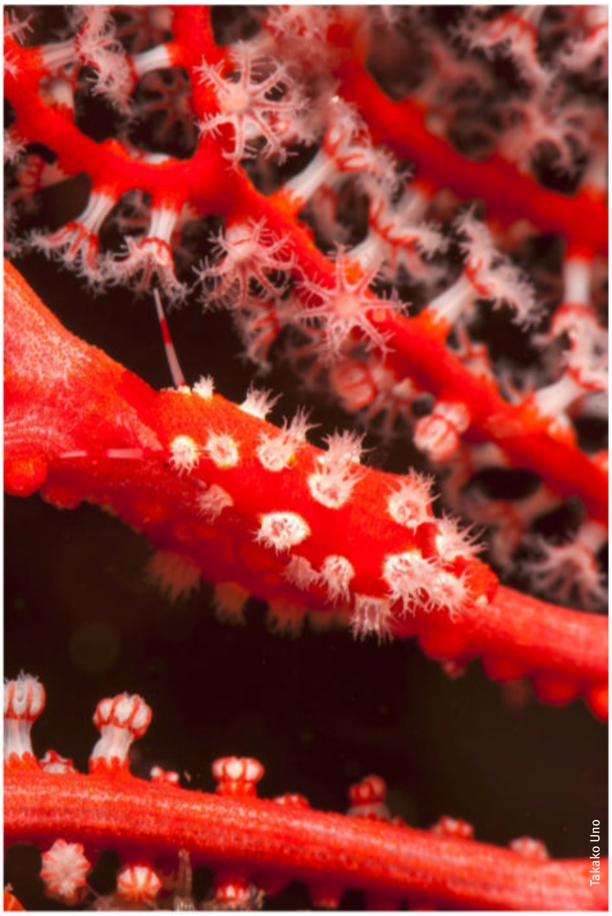

Takako Uno

Some corals increase the production of the colourful pigments from the green fluorescent protein family when they are exposed to more intense sunlight. Humans get a sun tan – corals become more colourful!

◄
Acalycigorgia sp.
(sea fan) at Rhino Rock,
Komodo, Indonesia

◄◄
Muricella sp. at Hot Rocks,
Komodo, Indonesia

◄◄◄
Alveopora sp. coral
at Manado, Indonesia

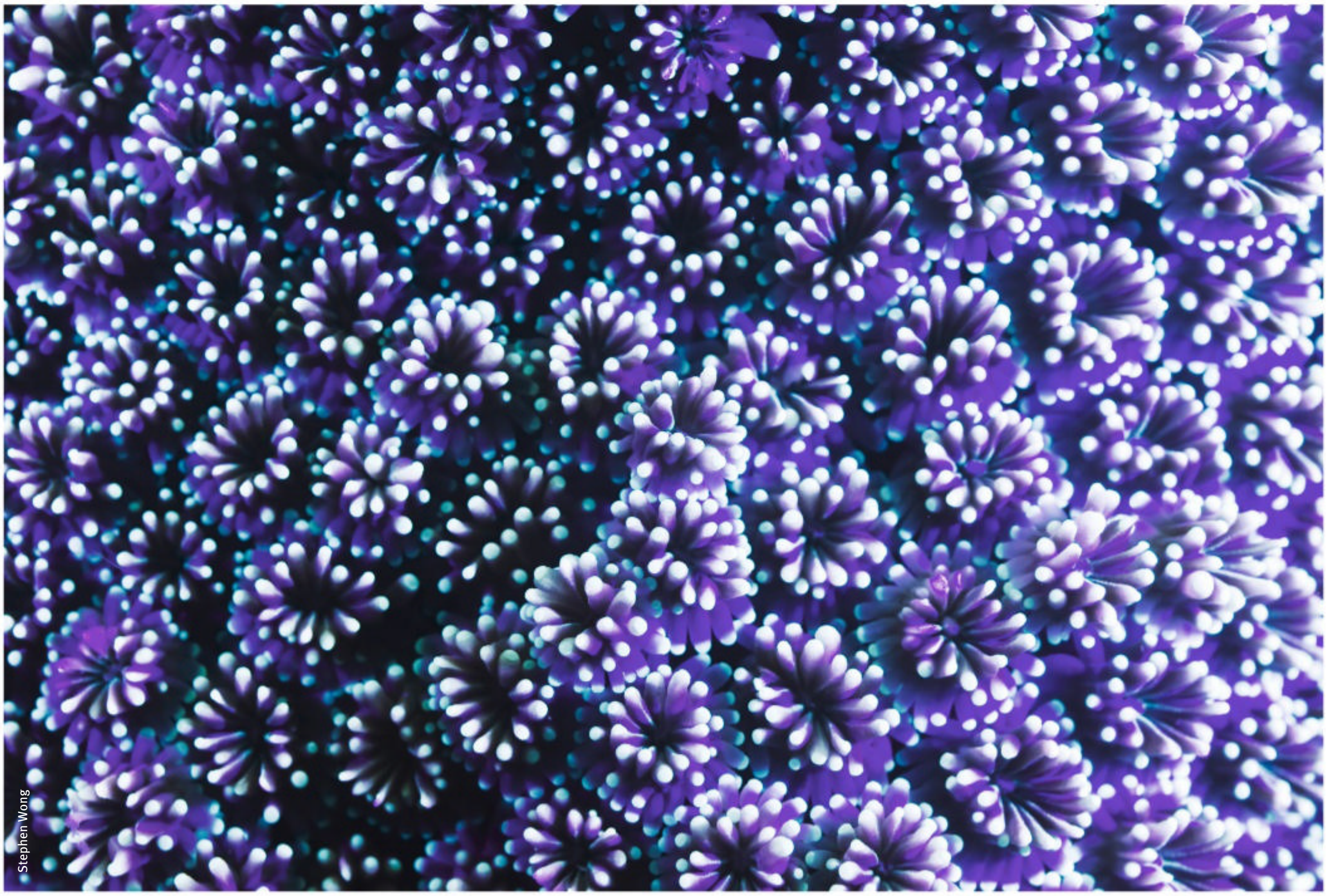
◄

▲
Bubble-tip anemone
(*Entacmaea quadricolor*)
Mini-wall, Kalabahi Bay,
Alor, Indonesia

▲◄
Spiky sea pen (*Pteroeides* sp.),
Nusa Kode, Komodo, indonesia

▲◄◄
Galaxea fascicularis at Cannibal
Rock, Komodo, Indonesia

▲◄◄◄
Fimbriaphyllia ancora in
Karang Banyangan, Misool,
Raja Ampat, Indonesia



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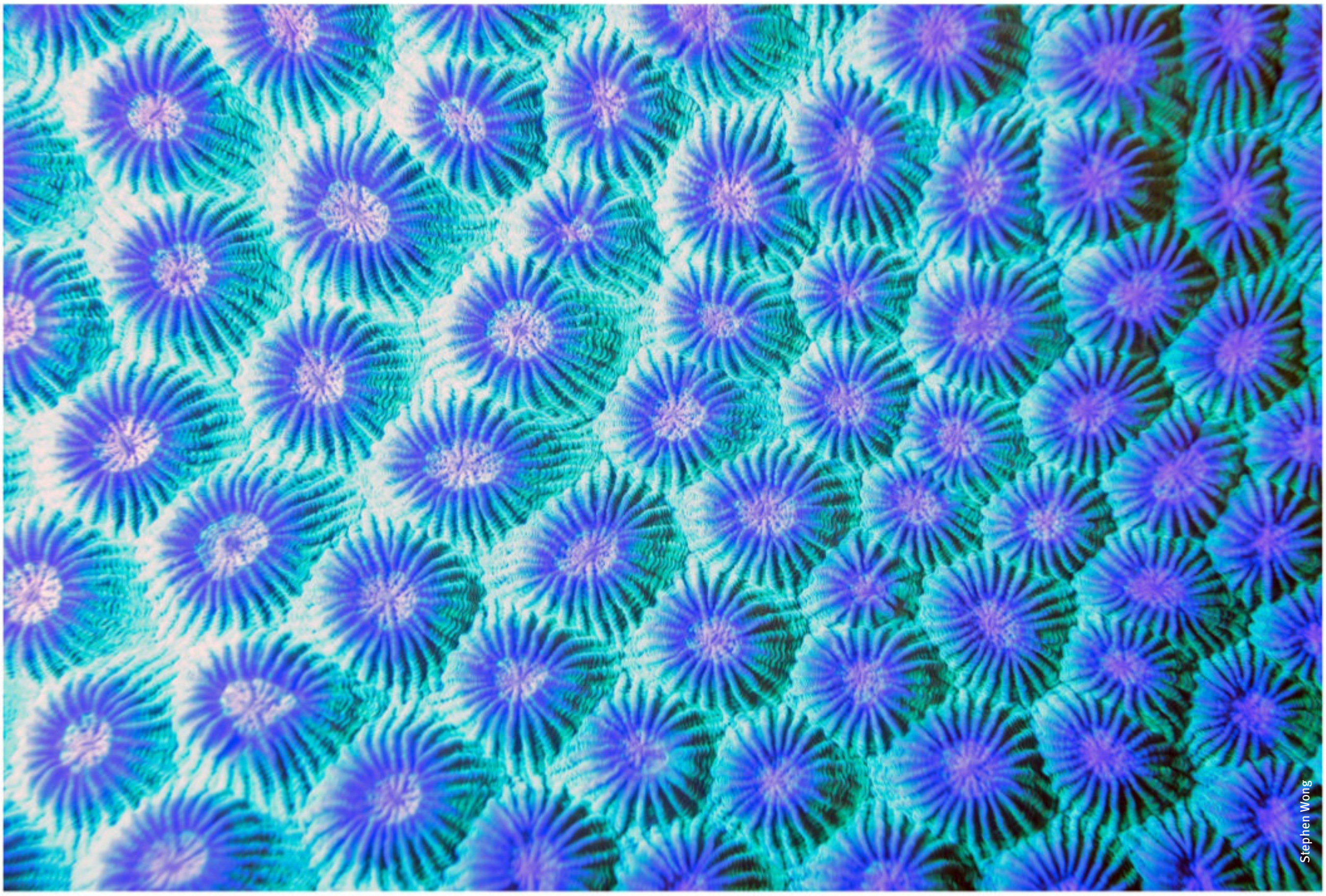
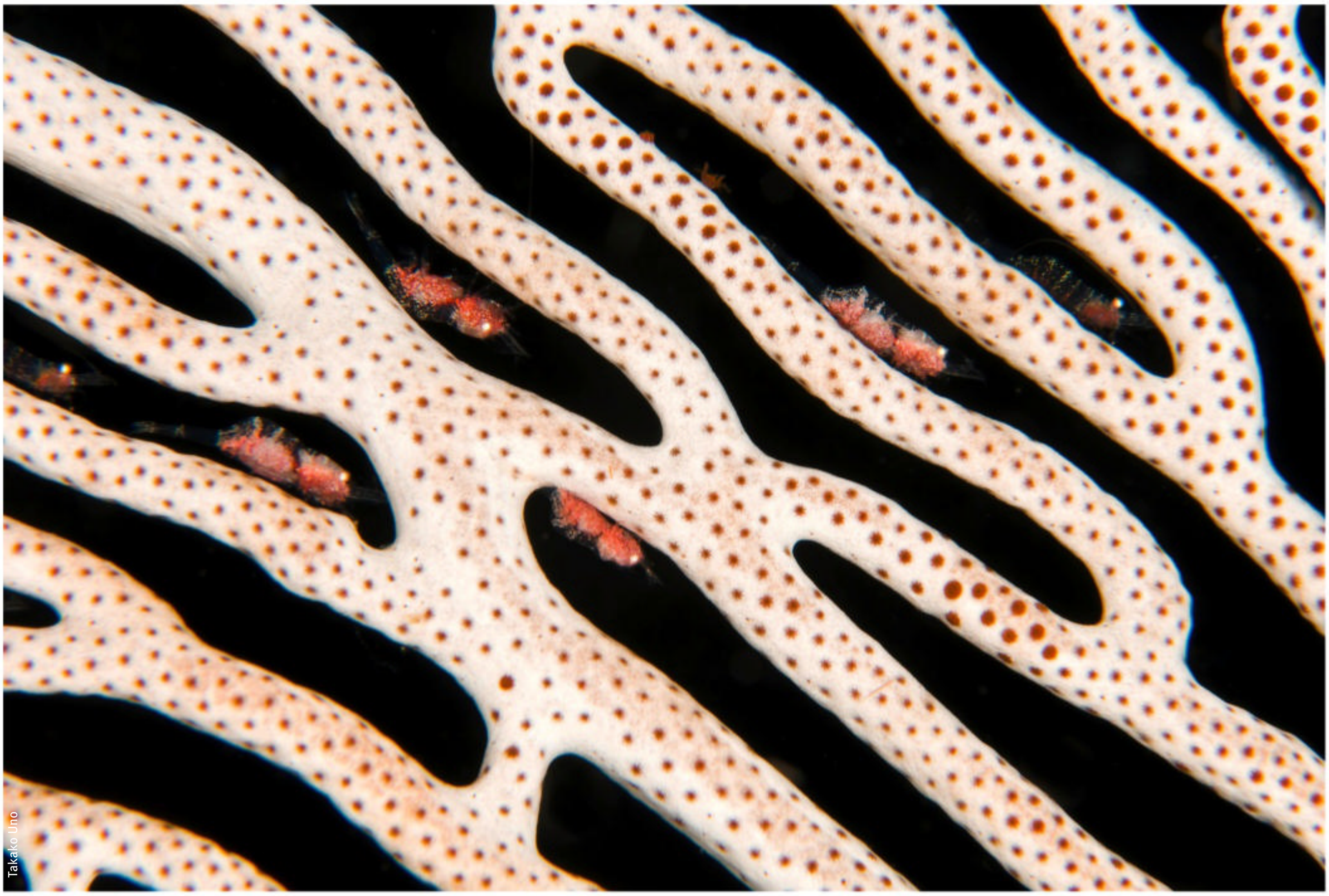


Stephen Wong



Takako Uno

◄▲
Detail of coral polyps (*Galaxea* sp.) growing on a healthy reef in Manado, Indonesia

◄▼
Favites is a genus of stony corals in the family Merulinidae

▲
Close-up of the giant sea fan *Annella mollis* (*Subergorgia mollis*)

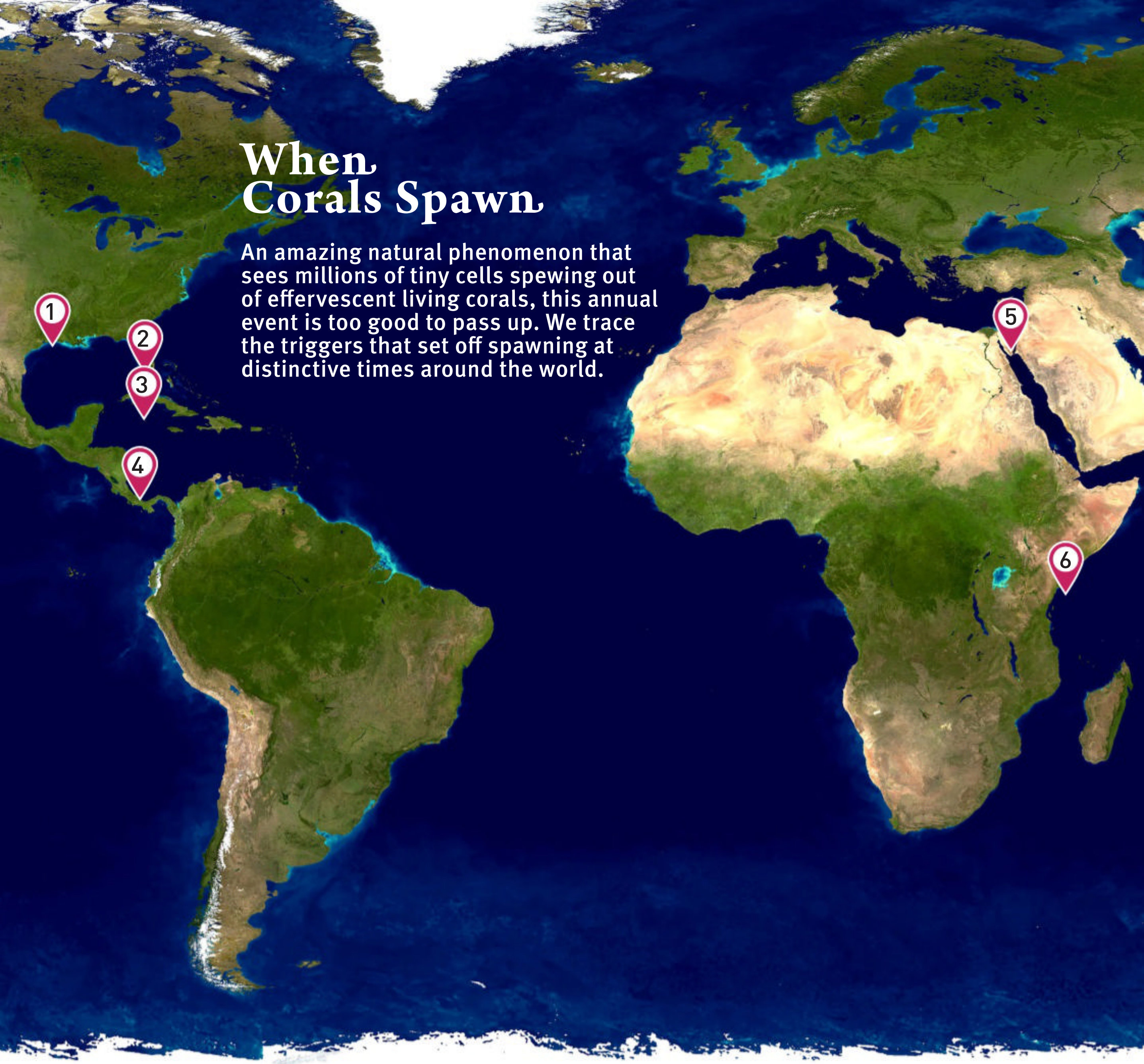
The future of coral reefs is strongly dependent on management strategies that can promote their recovery and resilience. The success of these efforts will rely on the identification of particularly vulnerable areas or regions affected by high levels of stress. We are convinced that it is in this context where the practical applications for coral pigments will become crucial. The colourful pigments can be used as indicators of mechanical stress or damage inflicted, for instance, by swimmers or divers. They could furthermore give an indication of parasites or diseases affecting corals. Understanding the functioning and dynamics of coral colour is a fundamental step in making it useful for coral reef monitoring. ◆ AG

DR CECILIA D'ANGELO, studied Biotechnology in Rosario, Argentina. She received her PhD with distinction in 2006 from the University of Münster in Germany. She is an Associate Professor at the University of Southampton, UK, where she studies the responses of corals to environmental stress.

PROFESSOR JÖRG WIEDENMANN, studied Biology in Ulm, Germany, and received his PhD in 2000 for his work on the biochemistry of fluorescent protein pigments of sea anamones. He is head of the Coral Reef Laboratory in the University of Southampton based at the National Oceanography Centre, Southampton, UK. He has received several prestigious awards for his research and teaching activities.

When Corals Spawn

An amazing natural phenomenon that sees millions of tiny cells spewing out of effervescent living corals, this annual event is too good to pass up. We trace the triggers that set off spawning at distinctive times around the world.



1
FLOWER GARDEN BANKS NATIONAL MARINE SANCTUARY, GULF OF MEXICO
- Aug (7–10 nights after full moon)
- The corals coordinate their efforts such that only one species is spawning at a time

2
FLORIDA KEYS, USA
- Aug/Sep (after full moon)
- Elkhorn coral and staghorn coral, both protected under the Endangered Species Act, can be seen spawning here

3
CAYMAN ISLANDS, WESTERN CARIBBEAN SEA
- Aug/Sep (after full moon)
- Star coral is the most abundant species, with colonies that spawn simultaneously and within a few seconds

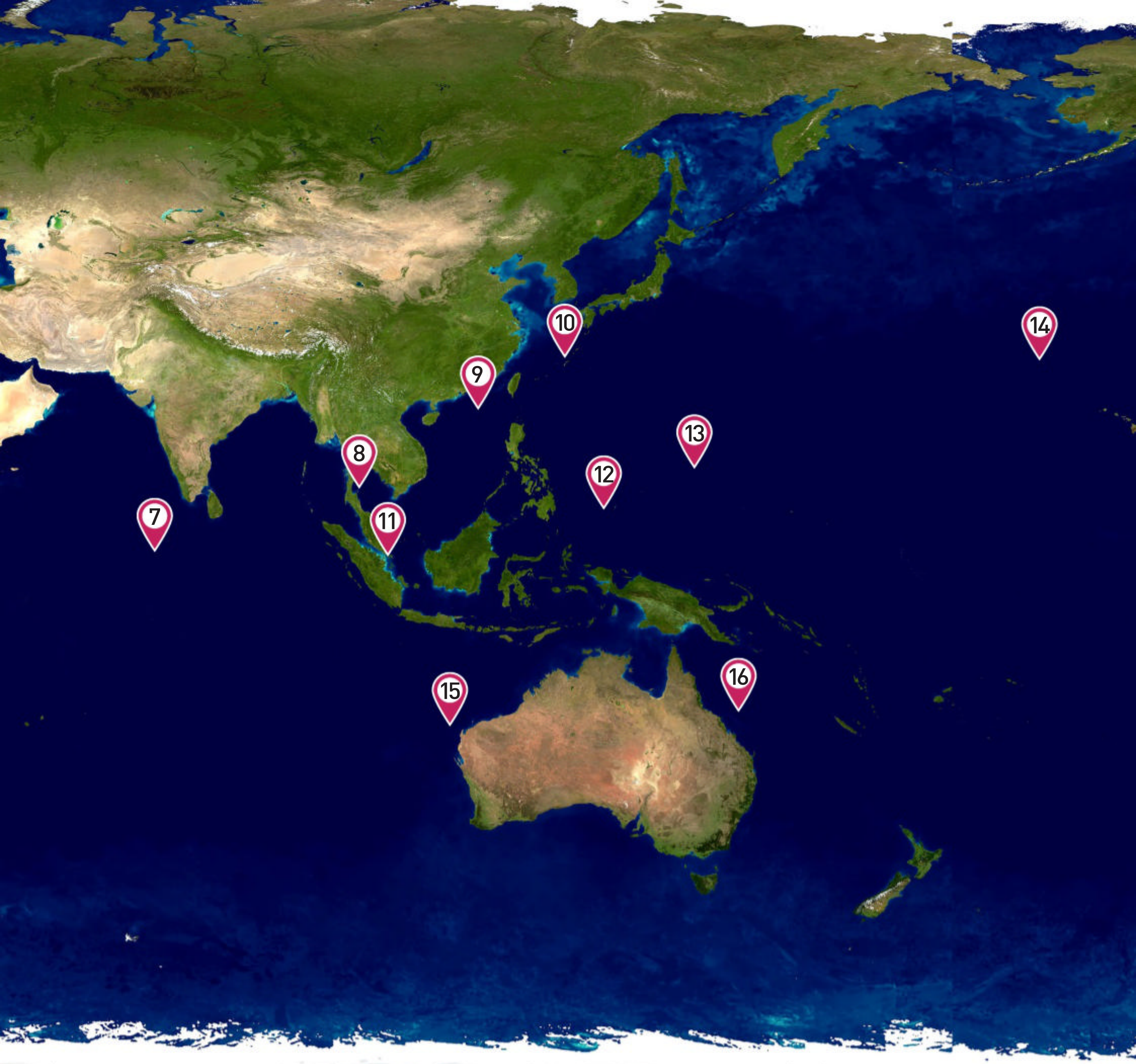
4
BOCAS DEL TORO, PANAMA (CARIBBEAN COAST)
- Sep (3–9 days after full moon)
- 5–7 days for most common species
- Several species spawn at the same time, yet the corals are able to avoid crossbreeding

5
GULF OF EILAT, RED SEA
- Jun–Sep
- The majority of corals spawn in summer, when algae populations decline and there is more space on reef flats

6
KENYA, AFRICA
- Oct–Apr
- Calm winds allow corals to reproduce before the eggs and sperm disperse, thus corals on Kenya's coast, which has months of light winds, have long spawning periods

7
MALDIVES
- Mar–Apr
- It is the norm for mass spawning events to take place in two subsequent months rather than one event a year

8
KOH TAO, THAILAND
- Mar
- Programmes are in place to capture coral eggs and sperm during spawning, for selective breeding and eventual restoration of the local reefs



9
DONGSHA ATOLL NATIONAL PARK, TAIWAN

- Apr
- Formed over 10 million years of reef building, this is the only fully developed coral atoll in Taiwan's waters

10
OKINAWA, JAPAN

- May–Sep
- Some species spawn over two or three months, so there is less synchrony, but the *Acropora* species' spawning is highly synchronised within the species

11
SINGAPORE

- Mar/Apr (after full moon)
- Singapore's reefs have almost half as many coral species as the Great Barrier Reef, but are only 0.01% its size

12
PALAU ARCHIPELAGO, MICRONESIA

- Apr–May
- April: Mainly stony corals spawn (*Acropora, Scleractinia*)
- May: Mainly non-*Acropora* corals spawn

13
GUAM, MICRONESIA

- Jul (about a week after full moon)
- Since Guam's wet season coincides with coral spawning and reduces fertilisation rates, researchers collect eggs to fertilise and culture before transplanting them to the reef

14
HAWAIIAN ISLANDS

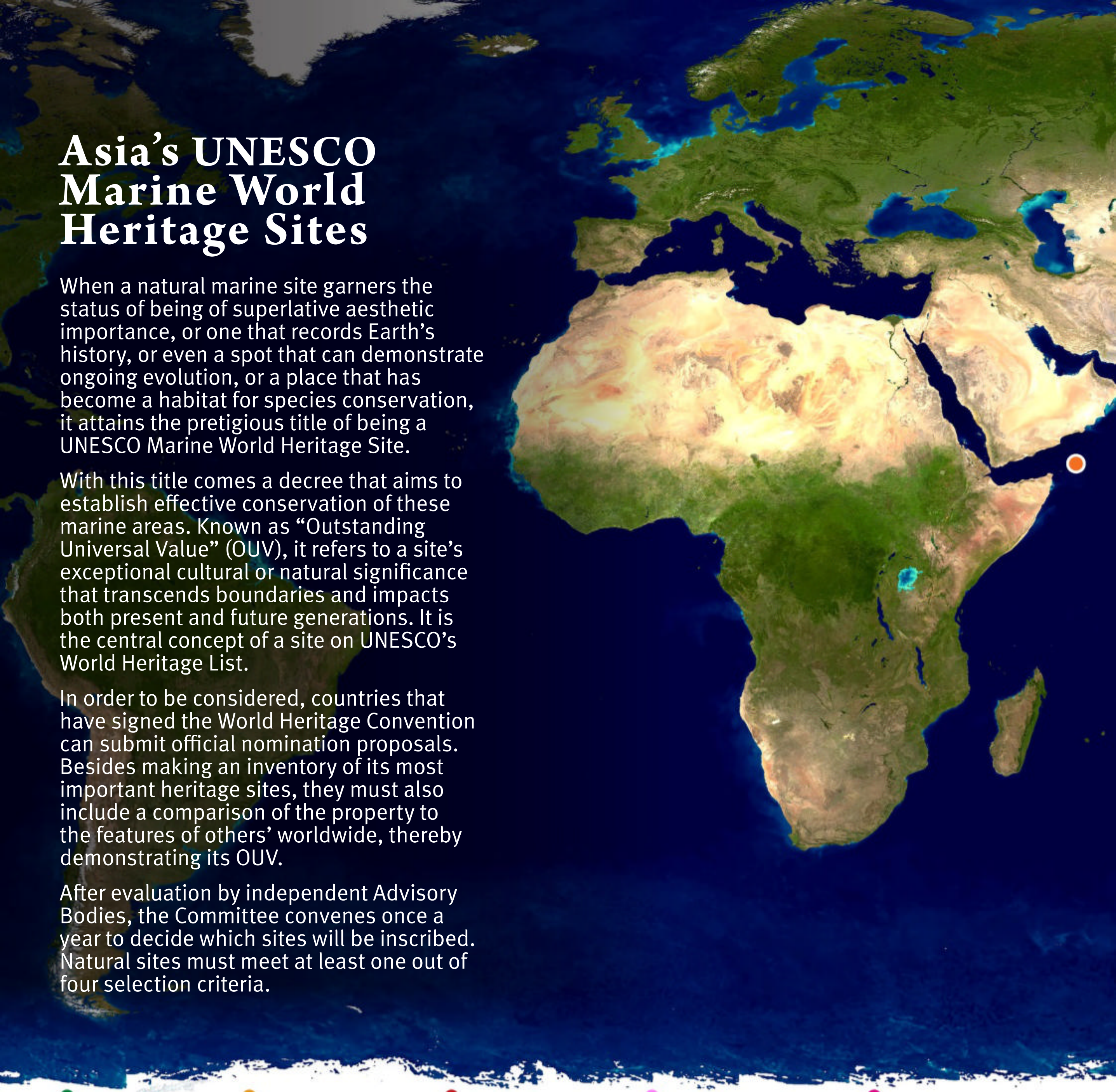
- Apr–Sep
- Hawaii is one of the few places where certain coral spawning can be observed during the day rather than the typical night phasing

15
NINGALOO, WESTERN AUSTRALIA

- Mar (on/after full moon night)
- More than 200 species of corals spawn and the waters are filled with brightly coloured polyps

16
GREAT BARRIER REEF, AUSTRALIA

- Oct–Nov: inshore reefs (after full moon)
- Nov–Dec: offshore, northern, southern reefs (after full moon)
- Mass coral spawning phenomenon (several species spawning simultaneously)



Asia's UNESCO Marine World Heritage Sites

When a natural marine site garners the status of being of superlative aesthetic importance, or one that records Earth's history, or even a spot that can demonstrate ongoing evolution, or a place that has become a habitat for species conservation, it attains the pretigious title of being a UNESCO Marine World Heritage Site.

With this title comes a decree that aims to establish effective conservation of these marine areas. Known as "Outstanding Universal Value" (OUV), it refers to a site's exceptional cultural or natural significance that transcends boundaries and impacts both present and future generations. It is the central concept of a site on UNESCO's World Heritage List.

In order to be considered, countries that have signed the World Heritage Convention can submit official nomination proposals. Besides making an inventory of its most important heritage sites, they must also include a comparison of the property to the features of others' worldwide, thereby demonstrating its OUV.

After evaluation by independent Advisory Bodies, the Committee convenes once a year to decide which sites will be inscribed. Natural sites must meet at least one out of four selection criteria.

1981
Great Barrier Reef, Australia
This site contains the world's largest collection of coral reefs, including 400 types of coral.

1987
Sundarbans National Park, India
The Sundarbans support threatened mammals suchas the Irrawaddy and Ganges River dolphins.

1991
Komodo National Park, Indonesia
Marine species richness is very high, including the blue whale and sperm whale.

1993
Tubbataha Reefs Natural Park, Philippines
The site is a pristine coral reef with a 100-metre perpendicular wall, lagoons and coral islands.

1997
Heard and McDonald Islands, Australia
The islands are virtually free of introduced species modification, providing an intact ecosystem.

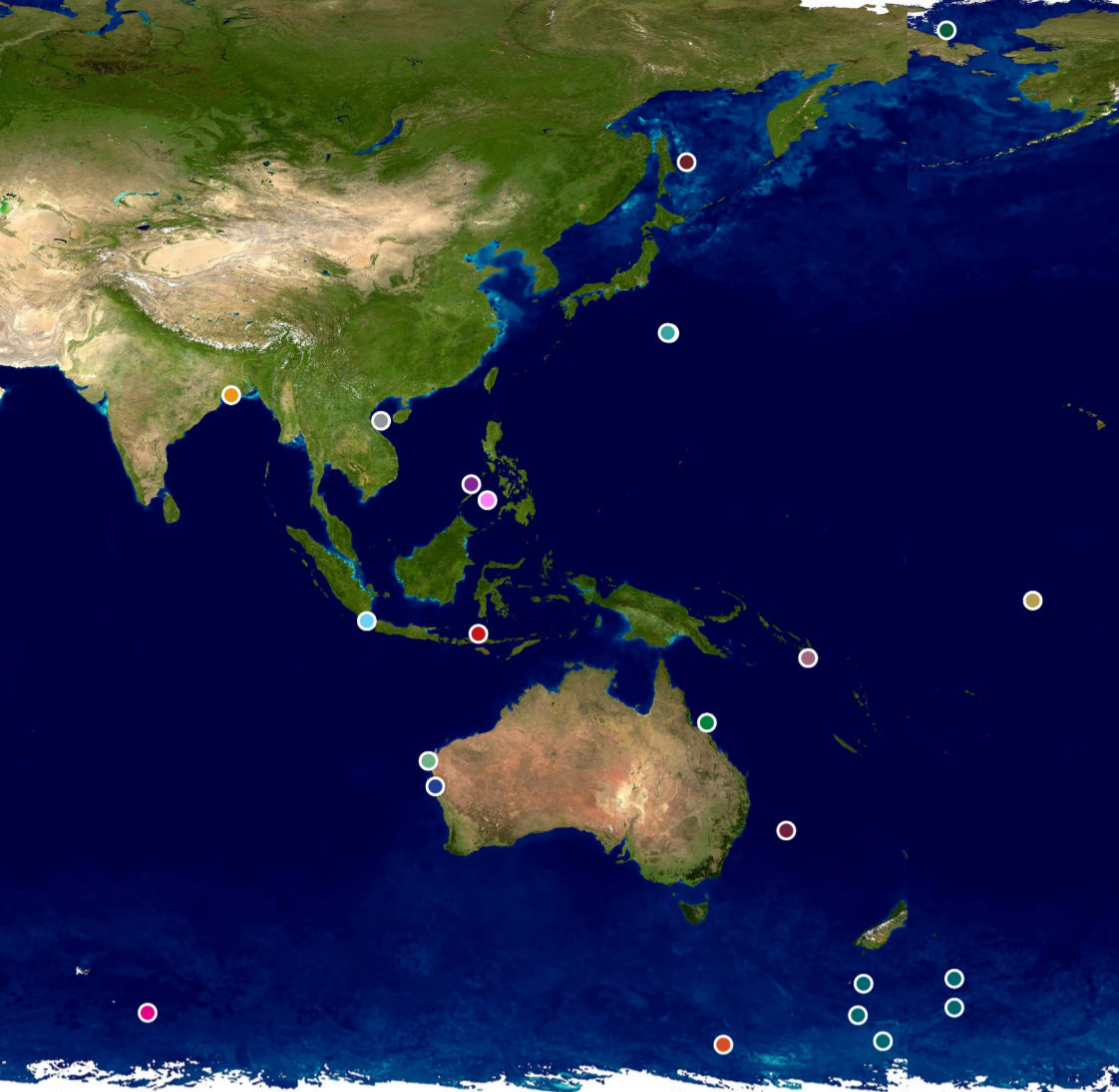
1982
Lord Howe Island Group, Australia
These islands boast a spectacular topography and are home to numerous endemic species, especially birds.

1991
Ujung Kulon National Park, Indonesia
The site is home to amphibians including the vulnerable estuarine crocodile.

1991
Shark Bay, Western Australia
The site's rich marine life includes a large population of dugongs (sea cows).

1994
Ha Long Bay, Cat Ba Archipelago, Vietnam
Featuring thousands of limestone karsts and islets, the bay is home to hundreds of fish, mollusc and coral species.

1997
The Sundarbans, Bangladesh
The site is knows for threatened species such as the estuarine crocodile.



● **1998**
New Zealand Sub-Antarctic Islands, New Zealand
The site features a close interdependence of marine and land environments for many species.

● **1999**
Puerto-Princesa Subterranean River National Park, Philippines
The site includes a subterranean river system that flows directly into the sea.

● **2005**
Shiretoko Peninsula, Japan
The site is globally important for marine mammals including Steller's sea lion.

● **2008**
Socotra Archipelago, Yemen
The marine life here includes 253 species of reef-building corals and 730 species of coastal fish.

● **2011**
Ogasawara Islands, Japan
The islands demonstrate evolutionary processes and feature many endemic species.

● **1997**
Macquarie Island, Australia
The site is home to thousands of penguins and elephant seals during breeding season.

● **1998**
East Rennell, Solomon Islands, Rennell and Bellona Province
Rennell, 86 km long and 15 km wide, is the largest raised coral atoll in the world.

● **2004**
Natural System of Wrangel Island Reserve, Russian Federation
This site is a major feeding ground for the grey whale migrating from Mexico.

● **2010**
Phoenix Islands Protected Area, Kiribati, Southern Pacific Ocean
The site conserves one of the largest intact oceanic coral archipelago ecosystems.

● **2011**
Ningaloo Coast, Australia
Annual gatherings of whale sharks occur at Ningaloo Coast.

Tales from the Black Sea

Text by **Bogdana Vashchenko**, Images by **Viktor Lyagushkin**

◆ ◆ ◆ **A glimpse of hope**

All eyes: When dolphins come into contact with bright light, a special covering comes down from their upper iris, while the pupil turns into an arc

That July morning is grey – as grey as our beings after days and nights on the road, and our ears are still ringing from the sound of the car engine. But every road has an end, and ours finishes at the gate of Utrish Marine Station, on the Russian coast of the Black Sea. My husband, photographer Viktor Lyagushkin, and I have driven 1,500 kilometres to get here, in search of a dolphin with an unusual destiny – a female bottlenose dolphin named Pashosh.

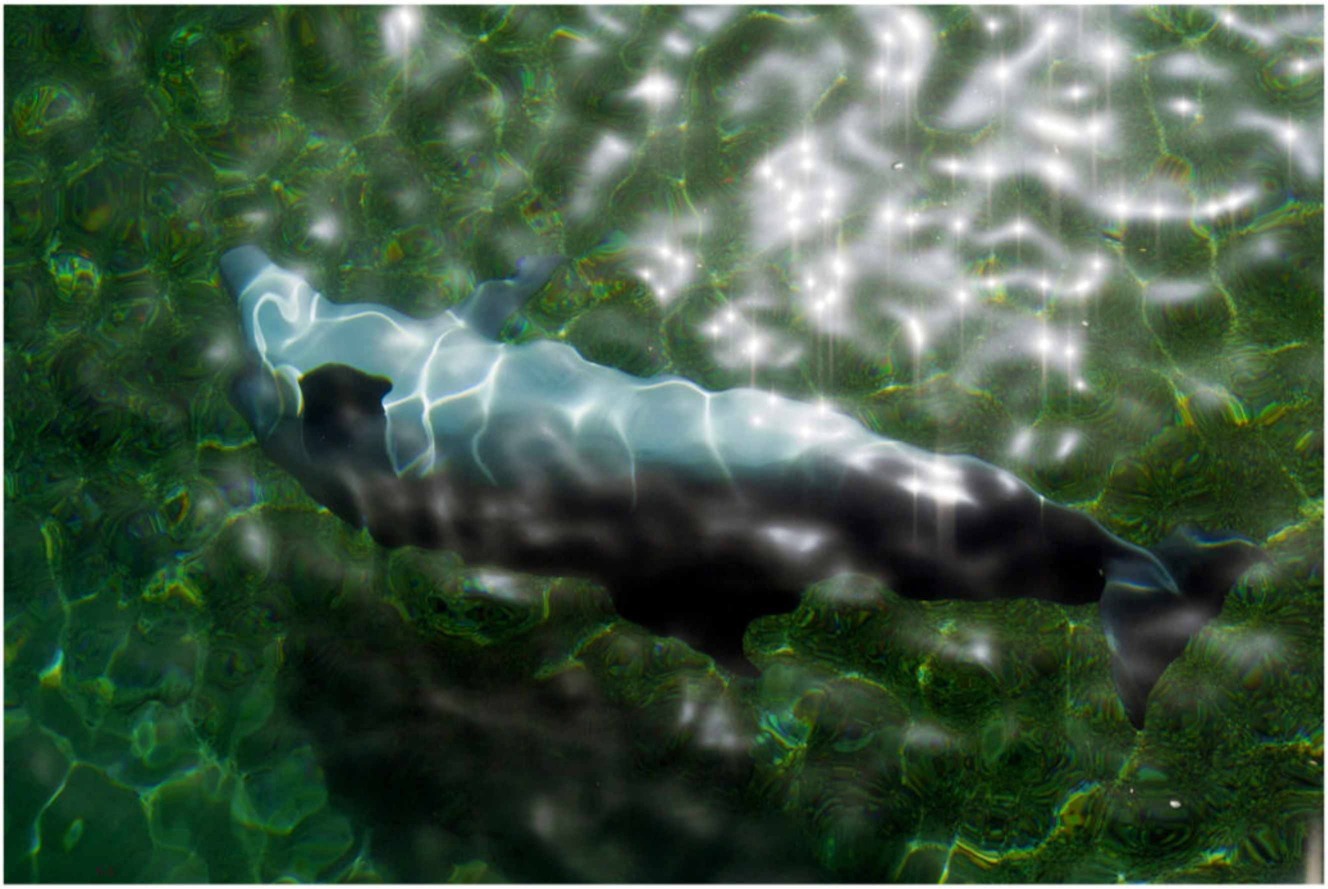
The bottlenose dolphin is the most common representative of the Delphinidae family. Bottlenose dolphins can be encountered almost anywhere in temperate and warm waters – from the Falkland Islands in the south to the coast of Greenland in the north. The Black Sea, however, is where it gets unusual – this location plays home to an endemic subspecies of bottlenose dolphins (*Tursiops truncatus ponticus*) that is referred to by communities along the Black Sea as "*afalina*", a name of Greek origins.

In the last century, the industrial extraction of dolphins in the Black Sea was in full swing until the prohibition of fishing by the Soviet Union, Bulgaria and Romania in 1966, followed by Turkey in 1983. Even as recent as 40 to 50 years ago, bottlenose dolphins were regularly trapped in trawling nets and killed. The ban on bottom trawling did not fix the problem – dolphins still died in the embrace of the poachers' nets.

The depletion of fish stocks, the deterioration of the ecology of the Black Sea as a whole and the slow reproduction of the animals, among other factors, have hauled this Black Sea bottlenose dolphin subspecies onto the IUCN Red List of Threatened Species under the "Endangered" category.

▼ The Black Sea bottlenose dolphin is listed as "Endangered" by the IUCN

▶ Bottlenose dolphins in the Black Sea are recognised to possess morphological differences from Atlantic and Pacific populations



The Utrish Marine Station at the Institute of Ecology and Evolution is situated on the seashore, close to the famous Abrau Durso winery. But now is not the time for champagne. Viktor needs to take photos for our book about dolphins, a book we have been working on for more than a year with a team of authors led by Eugene (John) Abramov, the head coach of the Gelendzhik Oceanarium. Picking John up in Gelendzhik, we are met at the Utrish Marine Station by its director and John's older brother, Andrew. He tells us about the fate of this one *afalina* with an exotic Jewish name, Pashosh.

"The history of the *afalina* started nearly a quarter of a century ago," Andrew begins, over percolating coffee. "In 1990, six *afalinas* left for permanent residence to Israel in the framework of a joint experiment by the USSR Academy of Sciences and Israeli scientists. They needed to determine how comfortable the Black Sea dolphins would feel at sea with higher salinity, and if they would be able to adapt quickly to the new environment.

"In the case of a successful adaptation, a small colony could become the basis for the breeding of *afalinas* in the Red Sea. This was rather timely, as by the 1990s, the population of the Black Sea bottlenose dolphins was declining quite rapidly. On top of that, food was becoming scarce."

The "settlers" quickly got accustomed to the new location – the eco-park Dolphin Reef in Eilat, Red Sea, Israel. They started to hunt local Red Sea fish and produced offspring. As the colony grew, however, conflicts arose between the animals and a few years later, it was decided a "repatriation" of bottlenose dolphins was necessary.

In 1996, a large dominant male named Dicky had been brought to the Utrish Marine Station and was successfully released into its home sea. Within a month, Dicky was spotted off the coast of Crimea in the company of wild bottlenose dolphins.

◄
When a dolphin breathes in, its heart rate increases so as to supply oxygen to its internal organs. When it holds its breath, the reverse happens

▼
Dolphin Reef, Eilat, Red Sea: While diving with dolphins here is possible, touching them is strictly prohibited

In 2006, two dolphins, brother and sister Shandy and Pashosh, were successfully released back into the Black Sea. Usually, even after a long stay in captivity, dolphins adapt well to the freedom of the open sea, and the example of Dicky had just confirmed this theory. In this case, however, it was a very different situation.

According to the theory, a dolphin should be released at the same spot where it is captured, giving it a higher chance of finding the pod. The animal would also know what fish to hunt, being familiar with the environment, water salinity and temperature. At home, Pashosh and her brother were free to leave the waters of Dolphin Reef. The problem was that the dolphins were born and raised in the Red Sea, making this relocation a risky one. So the scientists involved made sure they approached the task with the utmost seriousness.

Immigrants are usually held in quarantine for a month, until it becomes clear the animals are healthy. Upon release, Shandy headed towards Turkey and was never seen again. His sister Pashosh spent a few years along the northern Black Sea coast. Fishermen fed her from time to time, but it was obvious she was successfully hunting for herself. Then she disappeared for a long time. This year, however, somebody saw her again, and this is the reason we are here.

According to the theory, a dolphin should be released at the same spot where it is captured, giving it a higher chance of finding the pod. The animal would also know what fish to hunt, being familiar with the environment, water salinity and temperature.

"Why don't you attach a radio beacon to her? We would then be able to track her," I offer.

Andrew Abramov smiles. "Do you know what the beacon looked like back then?" he replies. "It was a huge thing attached to the dorsal fin of the animal with two bolts – yes, we had to make two holes in the dorsal fin. When the bolts rusted, the beacon fell off.

"First and foremost, it would be traumatic for the dolphin, which would already be under a lot of stress, having to deal with an unfamiliar environment. Secondly, we weren't sure if the local wild *afalinas* would adopt the newbie with such a big, strange object on its back. So we had to sacrifice this beacon of awareness in favour of Pashosh and her brother having a better chance of adapting."

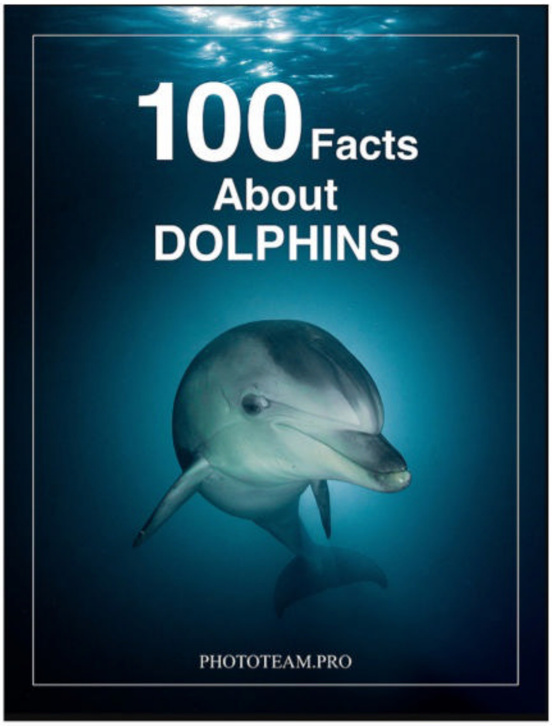
That evening, the weather worsens; the wind increases to almost storm levels. We leave for Cape Big Utrish the next day, arriving a little earlier than expected. The smiling owner of our boat, Tatar Karimych, explains that dolphins will come to feed in the evening, when the fish come close to the coast. It was Karimych who spotted Pashosh here a week earlier, near the Cape of Big Utrish.

"I know this dolphin very well. I was working on the trawler and she came to us a few years ago. She used to come up to us and smile! And her smile was so touching. It was impossible not to give her some fish!"

Because of the mark on the dorsal fin – the Latin letter "P", the first letter of her name, which reads as an "R" in Russian – the fishermen gave her their own Russian name, Romka. I am interested in how local fishermen treat dolphins. We are told some fishermen will shoot at *afalinas*, considering them direct competitors. Karimych frowns at this.

"Because they are stupid! A good fisherman knows how to cooperate with a dolphin. Mullets, for example, never willingly go into the net and bottlenose dolphins can drive the fish there. Just don't be so greedy; share your catch with a dolphin."

◄ Scientists can determine the age of a dolphin very precisely by counting the annual growth layers in its teeth



Learn more about the planet's most famous dolphin, the bottle-nosed dolphin in Bogdana Vashchenko and Viktor Lyagushkin's e-book *100 Facts about Dolphins*. Featuring more than 100 dolphin photographs, the e-book answers questions like: Are dolphins smart? Are they kind? How do they give birth? How do they master living in water? How do they hunt and what do they eat? Download from Apple Books.

DID YOU KNOW?

The 2022 Russian invasion of Ukraine has had a severe impact on the safety and numbers of Black Sea dolphins. It is estimated that tens of thousands of dolphins have died due to bombs dropped in coastal feeding areas as well as due to oil pollution and chemical runoff.

Possibly due to lack of food, wild Black Sea *afalinas* only live up to 20 or 30 years – almost half the life expectancy of their Atlantic relatives

When the sun begins to slope below the horizon, we set out to sea. We head to the same place where Karimych saw Pashosh, but there are no dolphins. Karimych talks to someone on his cell: "Where are you? At 60? Are there any dolphins? I have photographers on-board. They badly need some dolphins!"

He smiles at us. "We shall see dolphins for sure, with a doubt, but I cannot promise you that we'll find Romka. The fisherman explained that because of yesterday's storm, the situation out at sea has changed. Schools of fish are gone and probably, the dolphins have followed their prey."

Quite far from the coast, we find a small trawler, escorted by two pods at a considerable distance: common dolphins swimming farther out to sea and a pod of six bottlenose dolphins keeping closer to the shore.

"Do you see where they are diving?" Karimych asks. "There is a net with fish there. The trawl is large and no matter how thoroughly you prepare it, there will always be some holes. The fish run out of the holes like water streams from a tap. And a dolphin need not do anything but go to the fish stream and open its mouth!"

Some time later, the ship begins to pull up the trawl. When the net is on board, the common dolphins hold back in the open sea, while the bottlenose dolphins rush back to Utrish. We decide to follow them.

By the time we catch up with the pod, they are already in full hunting mode. Dolphins go down and disappear for a long time, then rest for a while on the surface before diving again. You could clearly observe the system they used for their dives.

John Abramov explains, "This is a classic method called 'pot', where dolphins dive from different sides, knocking a school into a dense mass. Some animals herd the fish, shuttling from the bottom to the surface, narrowing the corridor and pushing the fish up to the surface. Meanwhile, other dolphins feed by diving into the 'pot'. Then they change places with the beaters."

Viktor asks Karimych to approach the pod so he can take pictures of the dolphins against the backdrop of the setting sun, but for some reason, the dolphins, which were not paying attention to us before, begin to avoid us.

"People used to capture them in this way, so they are sensitive to such manoeuvres," notes Karimych.

John doesn't agree. "Nobody has done this for several decades. It is unlikely they remember how they were caught. Another thing is the sound of the engine and the direction of our movement has changed. Bottlenose dolphins prefer to avoid all incomprehensible situations."

We leave the animals alone and turn homeward. John explains that mothers with pups and the old, experienced females gather in groups called the "nursery". Usually, they can be encountered at the shoals along the Black Sea coast. There are many such groups in the storm-protected Taman Gulf, where depth does not exceed seven metres and there is enough fish for the mothers.

"And, by the way, there were several pups in the pod where I saw Romka!", Karimych chimes in. That could be one explanation for what happened to our *afalina*. Pods with calves cannot hunt in deep areas, so the group that Pashosh joined stayed along shallow banks near the shore. Because of the storm, fish left for the deep, and mothers with calves had to go looking for a new location.

So, we are a little late, though we are still lucky to have met the Black Sea bottlenose dolphins and observe them in the wild. In recent years, sailors' polls show that the population of bottlenose dolphins in the Black Sea is growing. We are hopeful that these wonderful animals will not remain on the dreaded IUCN Red List for long. ◆ AG

BOGDANA VASHCHENKO, MSc, journalist and author of the books *Orda Cave Awareness and Being a Dolphin*, believes that the world is beautiful and surprising in all its manifestations. She lives by the motto of the brave little mongoose Rikki-Tikki-Tavi from the eponymous Rudyard Kipling story: "Run and find out!"

VIKTOR LYAGUSHKIN, National Geographic photographer, Nikon Ambassador, and Subal Team Pro photographer, has won numerous international photo contests. His exhibitions have been held in various cities across Europe and the US, and he has been published more than 1,000 times in the most prominent and respected international magazines and newspapers.

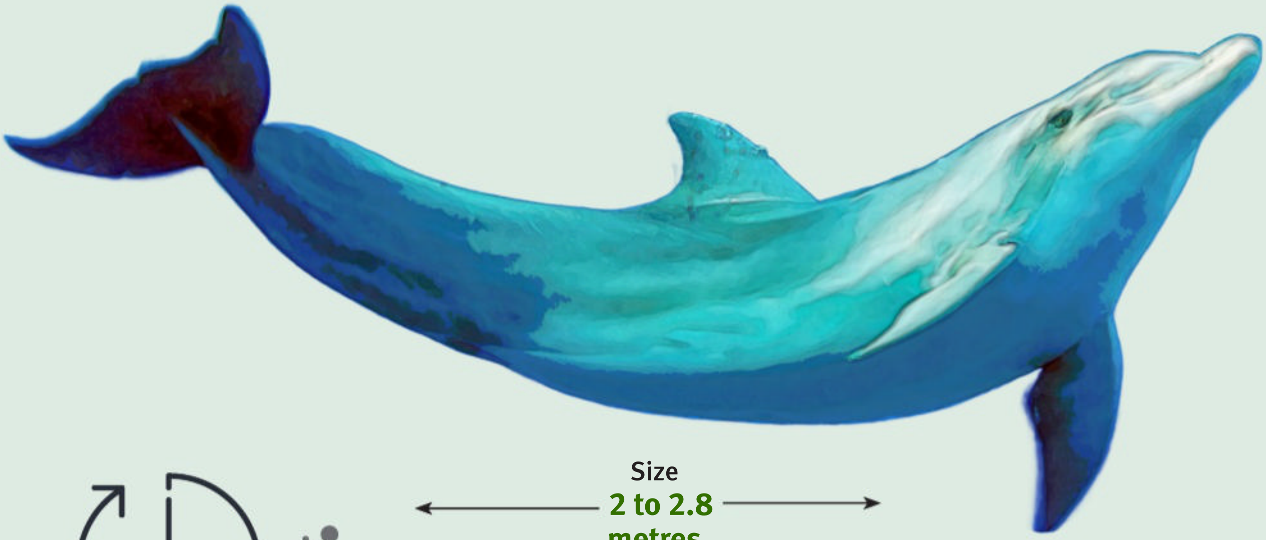
Black Sea Bottlenose Dolphins

Scientific Name : ***Tursiops truncatus ponticus***

CONSERVATION STATUS

EX EW CR **EN** VU CD NT LC

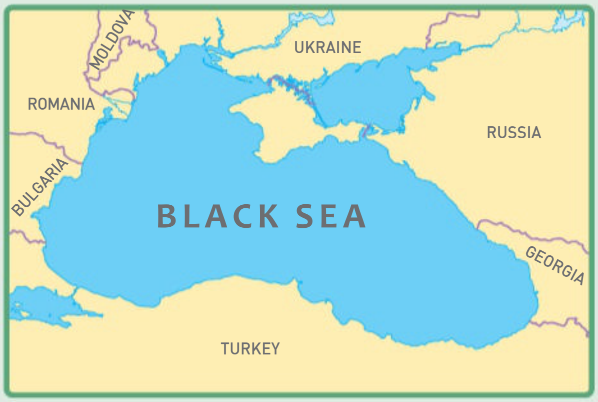
Extinct Threatened Least Concern

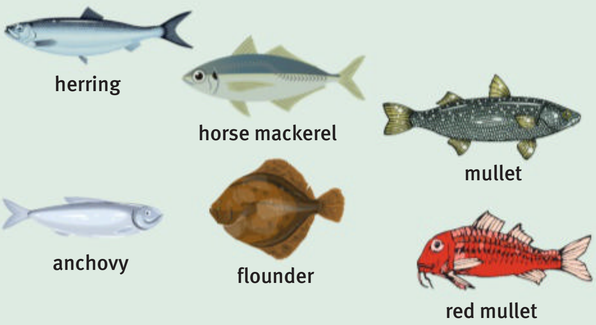


Size
2 to 2.8 metres

Average lifespan
20 to 32 years

Weight around
600 kg


MOLDOVA
UKRAINE
ROMANIA
RUSSIA
BULGARIA
BLACK SEA
GEORGIA
TURKEY


herring
horse mackerel
mullet
anchovy
flounder
red mullet

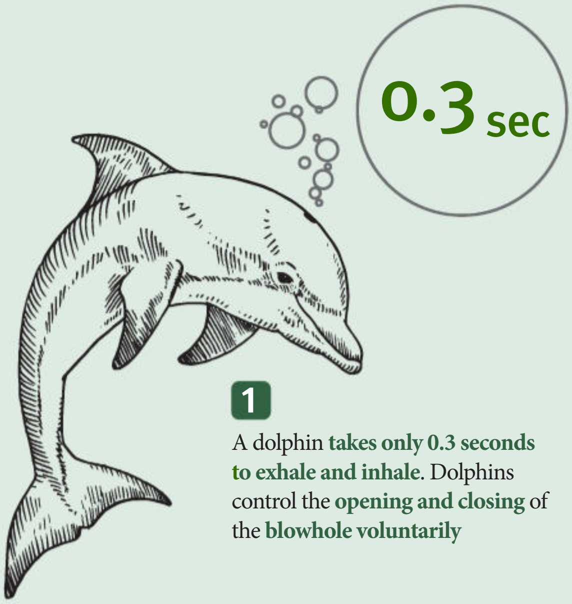
Habitat

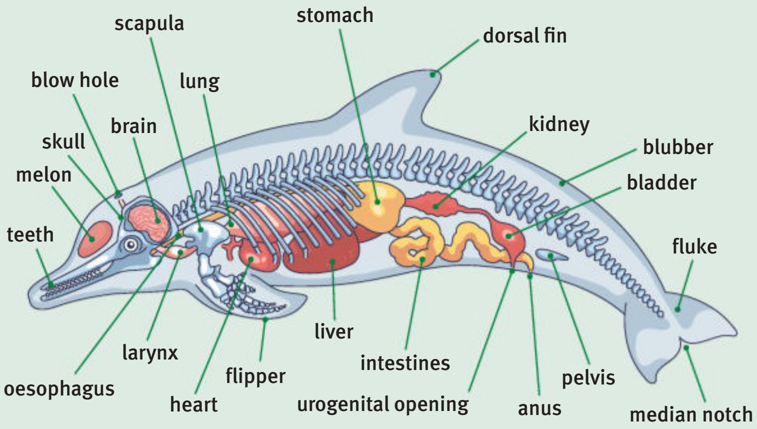
Black Sea bottlenose dolphins inhabit the coastal and deeper waters of the Black Sea, with a **preference for shallower areas (under 200 meters)**

Diet

Primarily consists of various fish species, including **herring**, **horse mackerel**, **mullet**, **anchovy**, **flounder**, and **red mullet**

5 Things You Never Knew About Dolphins



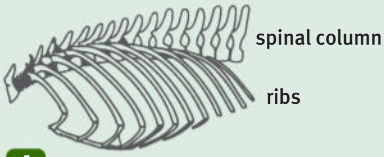

scapula
stomach
dorsal fin
blow hole
lung
brain
skull
melon
teeth
kidney
blubber
bladder
fluke
larynx
oesophagus
heart
flipper
liver
intestines
urogenital opening
anus
pelvis
median notch

1

A dolphin **takes only 0.3 seconds to exhale and inhale**. Dolphins control the **opening and closing** of the **blowhole voluntarily**

2

A network of complex nerve **endings senses pressure changes** so the **animal knows** when its **blowhole is clear of the water** and it is **safe to breathe**


spinal column
ribs

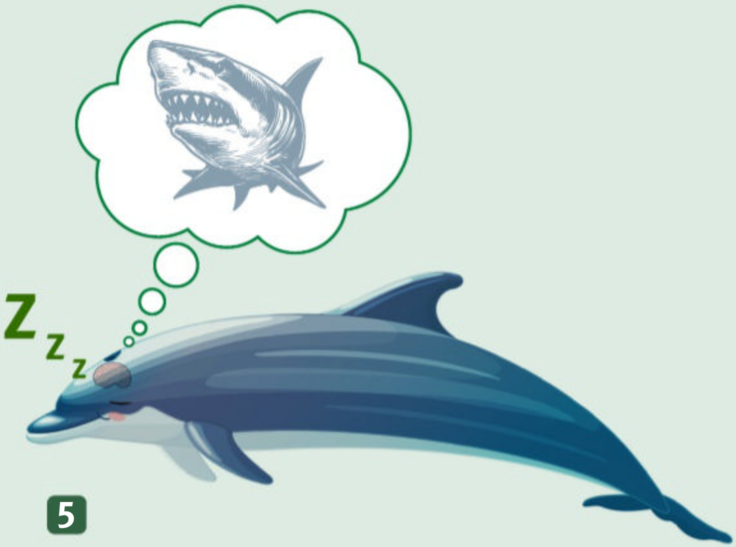
4

A dolphin's body has adapted to avoid decompression sickness by completely collapsing its ribcage, forcing the air under pressure out of its lungs into the windpipe

Wikipedia

3

Dolphins have been serving in the US Navy for **more than 40 years** as part of its **Marine Mammal Program**, and were deployed during the **Vietnam War** and **Operation Iraqi Freedom**. The highly intelligent animals are trained to **detect, locate** and **mark sea mines**



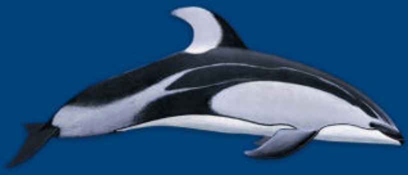
5

Dolphins **sleep by resting one side of the brain** at a time, allowing them to continue **rising to the surface for air** and to **watch out for predators**

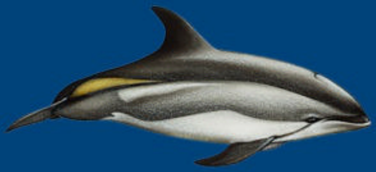
Reflections

A Dizzying Display of Dolphins

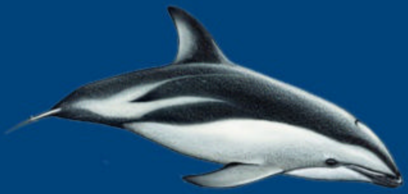
Family: *Delphinidae*



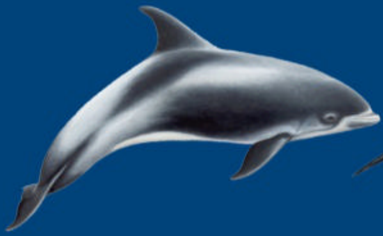
PACIFIC WHITE-SIDED DOLPHIN
Lagenorhynchus obliquidens



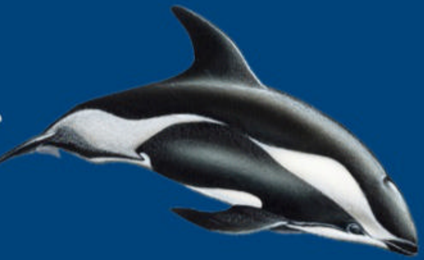
ATLANTIC WHITE-SIDED DOLPHIN
Lagenorhynchus acutus



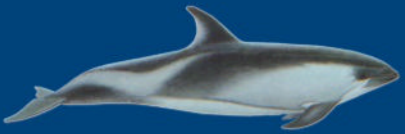
DUSKY DOLPHIN
Lagenorhynchus obscurus
Subspecies:
African dusky dolphin (*L. o. obscurus*)
Fitzroy's dolphin (*L. o. fitzroyi*)
Peruvian/Chilean dusky dolphin (*L. o. posidonia*)
New Zealand dusky dolphin (*Unnamed subspecies*)



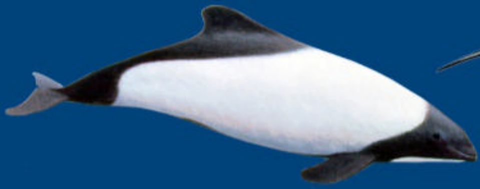
WHITE-BEAKED DOLPHIN
Lagenorhynchus albirostris



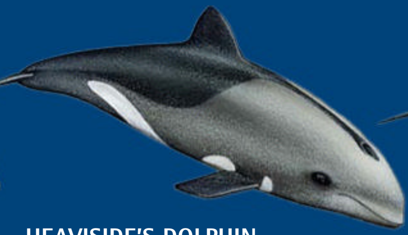
HOURGLASS DOLPHIN
Lagenorhynchus cruciger



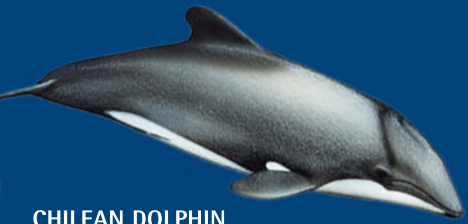
PEALE'S DOLPHIN
Lagenorhynchus australis



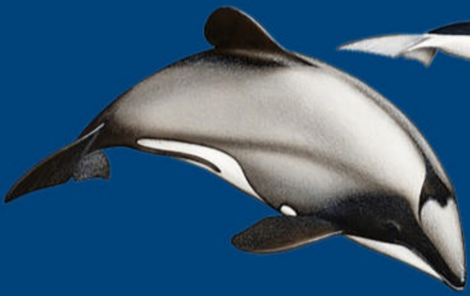
COMMERSON'S DOLPHIN
Cephalorhynchus commersonii
Subspecies:
C. c. commersonii
C. c. kerguelenensis



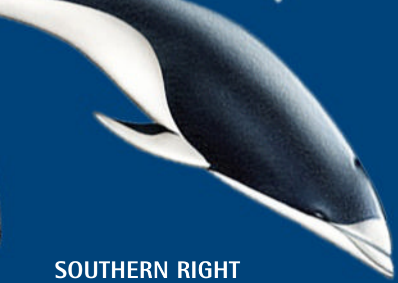
HEAVISIDE'S DOLPHIN
Cephalorhynchus heavisidii



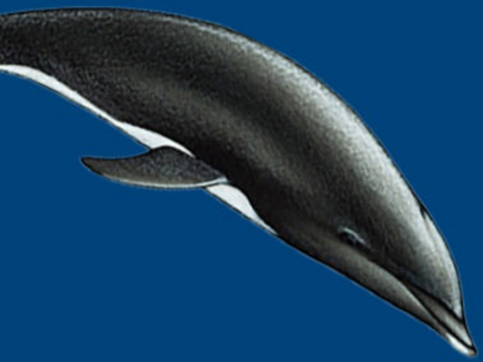
CHILEAN DOLPHIN
Cephalorhynchus eutropia



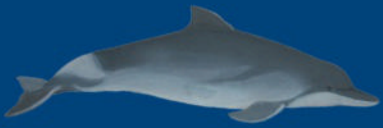
**HECTOR'S DOLPHIN,
NEW ZEALAND DOLPHIN**
Cephalorhynchus hectori
Subspecies:
South Island Hector's dolphin (*C. h. hectori*)
Maui's dolphin, North Island Hector's dolphin (*C. h. maui*)



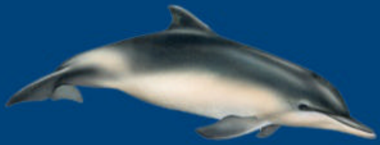
**SOUTHERN RIGHT
WHALE DOLPHIN**
Lissodelphis peronii



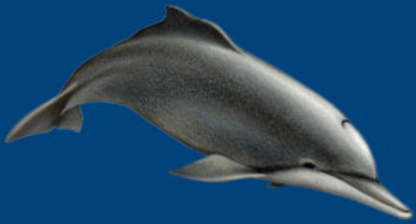
**NORTHERN RIGHT
WHALE DOLPHIN**
Lissodelphis borealis



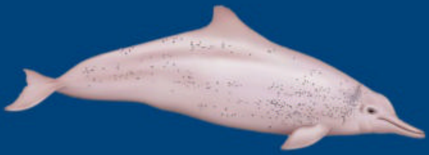
GUIANA DOLPHIN, COSTERO
Sotalia guianensis



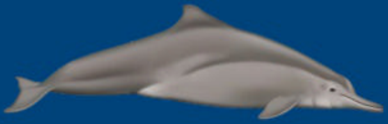
TUCUXI
Sotalia fluviatilis



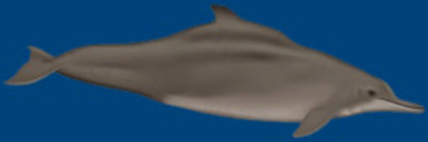
ATLANTIC HUMPBACK DOLPHIN
Sousa teuszii



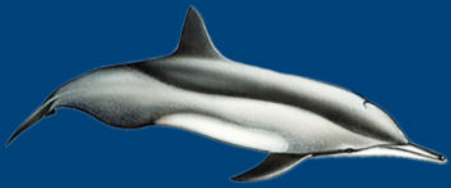
PACIFIC HUMPBACK DOLPHIN
Sousa chinensis



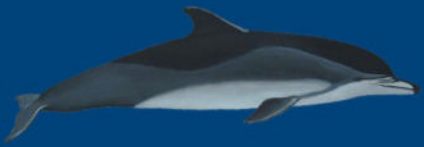
AUSTRALIAN HUMPBACK DOLPHIN
Sousa sahulensis



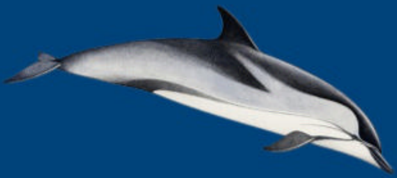
INDIAN OCEAN HUMPBACK DOLPHIN
Sousa plumbea



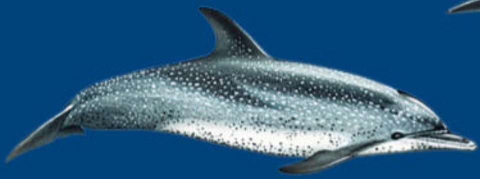
SPINNER DOLPHIN
Stenella longirostris
Subspecies:
Gray's spinner dolphin (*S. l. longirostris*)
Eastern spinner dolphin (*S. l. orientalis*)
Dwarf spinner dolphin (*S. l. roseiventris*)
Central American spinner dolphin (*S. l. centroamericana*)



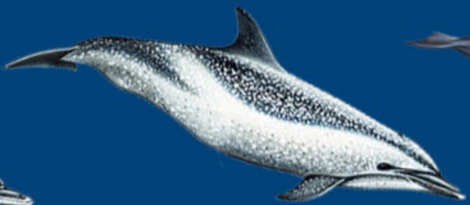
CLYMENE DOLPHIN
Stenella clymene



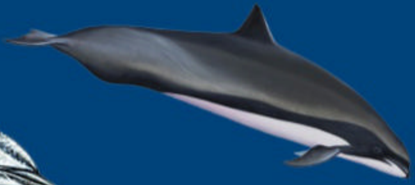
STRIPED DOLPHIN
Stenella coeruleoalba



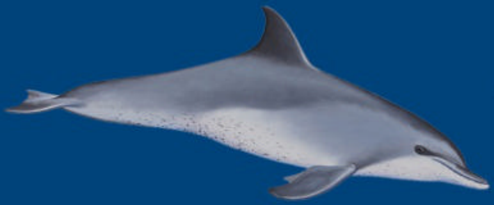
ATLANTIC SPOTTED DOLPHIN
Stenella frontalis



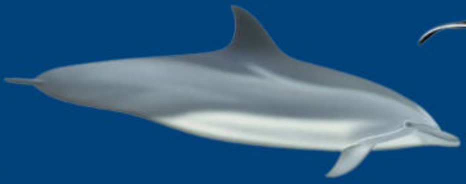
PANTROPICAL SPOTTED DOLPHIN
Stenella attenuata
Subspecies:
Offshore pantropical spotted dolphin (*S. a. attenuata*)
Coastal pantropical spotted dolphin (*S. a. graffmani*)



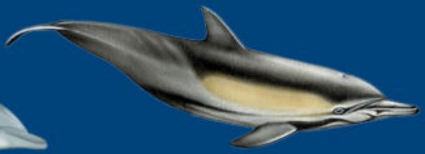
FRASER'S DOLPHIN
Lagenodelphis hosei



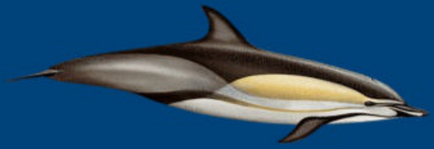
**INDO-PACIFIC
BOTTLENOSE DOLPHIN**
Tursiops aduncus



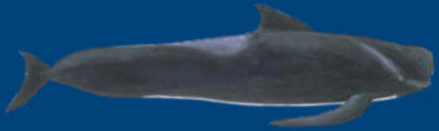
COMMON BOTTLENOSE DOLPHIN
Tursiops truncatus
Subspecies:
Black Sea bottlenose dolphin (*T. t. ponticus*)



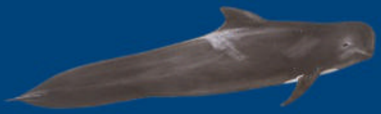
LONG-BEAKED COMMON DOLPHIN
Delphinus capensis
Subspecies:
Long-beaked common dolphin (*D. c. capensis*)
Indo-Pacific common dolphin (*D. c. tropicalis*)



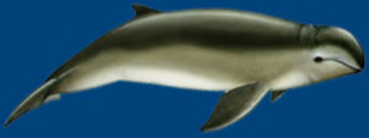
**SHORT-BEAKED COMMON
DOLPHIN, SADDLEBACK DOLPHIN**
Delphinus delphis
Subspecies:
Short-beaked common dolphin (*D. d. delphis*)
Black Sea common dolphin (*D. d. ponticus*)
Baird's common dolphin (*D. d. bairdii)*
Arabian common dolphin (*D. d. tropicalis*)



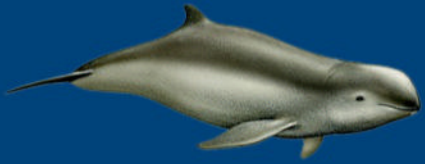
LONG-FINNED PILOT WHALE
Globicephala melas
Subspecies:
North Atlantic long-finned pilot whale
(*G. m. melas*)
Southern long-finned pilot whale
(*G. m. edwardii*)
North Pacific long-finned pilot whale
(*Unnamed subspecies*)



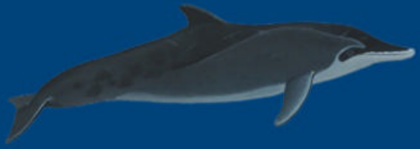
SHORT-FINNED PILOT WHALE
Globicephala macrorhynchus



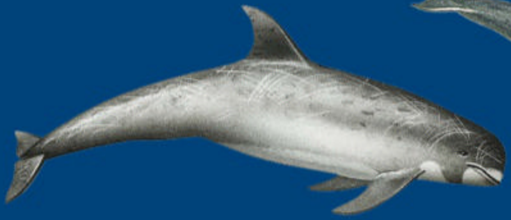
**AUSTRALIAN
SNUBFIN DOLPHIN**
Orcaella heinsohni



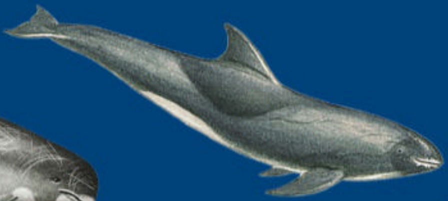
IRRAWADDY DOLPHIN, PESUT
Orcaella brevirostris



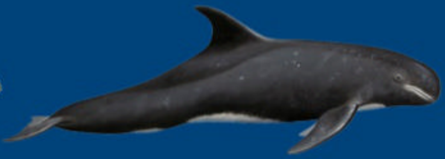
ROUGH-TOOTHED DOLPHIN
Steno bredanensis



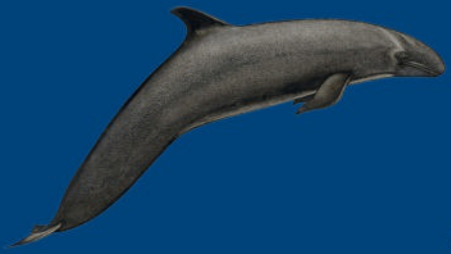
**RISSO'S DOLPHIN,
GREY GRAMPUS**
Grampus griseus



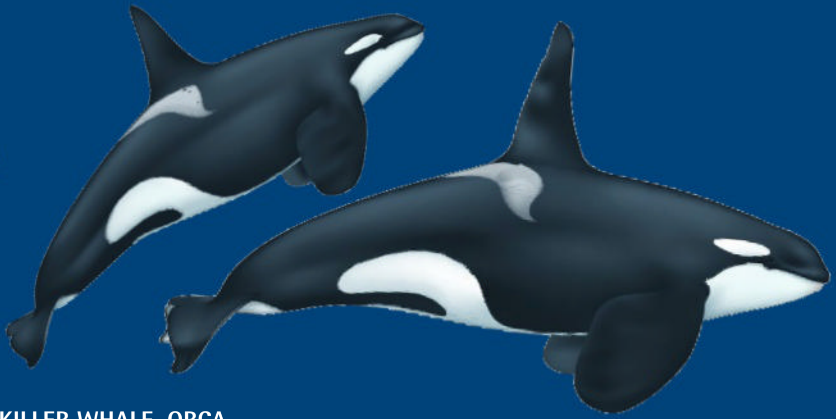
**MELON-HEADED WHALE,
ELECTRA DOLPHIN**
Peponocephala electra



PYGMY KILLER WHALE
Feresa attenuata



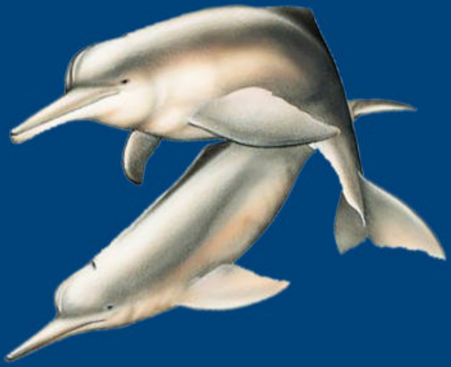
FALSE KILLER WHALE
Pseudorca crassidens



KILLER WHALE, ORCA
Orcinus orca
Resident killer whale (*Unnamed subspecies*)
Transient killer whale, Bigg's killer whale
(*Unnamed subspecies*)

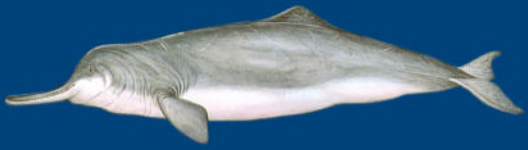
Family: *Iniidae*

AMAZON RIVER DOLPHIN
Inia geoffrensis
Subspecies:
Boto (*I. g. geoffrensis*)
Orinoco bufeo (*I. g. humboldtiana*)
Bolivian bufeo (*I. g. boliviensis*)



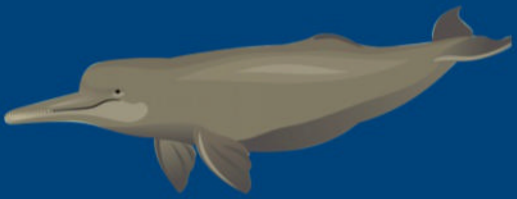
Family: *Lipotidae*

BAIJI, YANGTZE RIVER DOLPHIN
Lipotes vexillifer
Critically Endangered, possibly extinct



Family: *Platanistidae*

SOUTH ASIAN RIVER DOLPHIN, INDIAN RIVER DOLPHIN
Platanista gangetica
Subspecies:
Susu, Ganges river dolphin (*P. g. gangetica*)
Bhulan, Indus river dolphin (*P. g. minor*)



Cetaceans

(Whales, Dolphins, and Porpoises)

Cetacean species are divided into two groups:

①

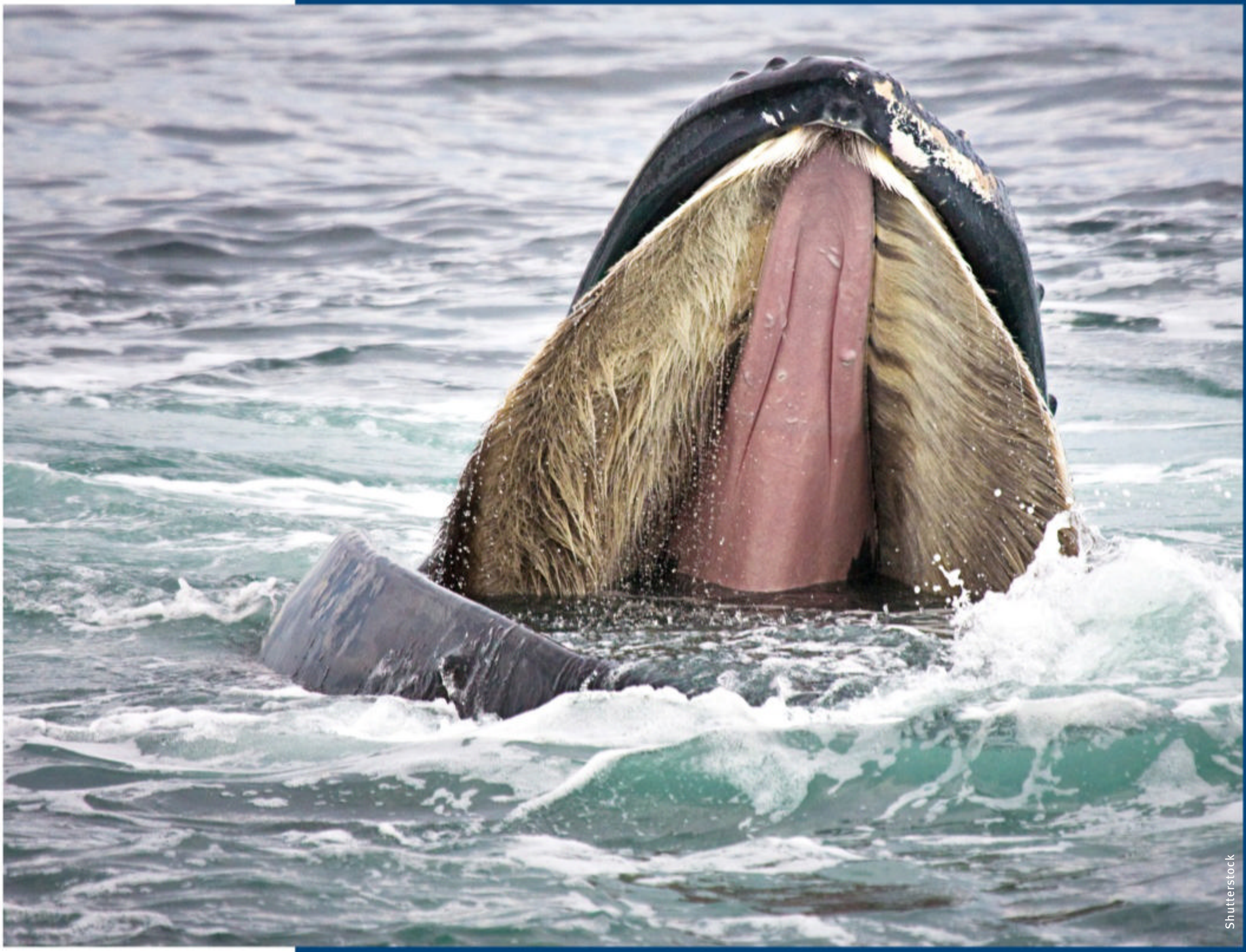
Baleen whales

(also known as whalebone whales)

- Baleen whales all have baleen plates that are used to filter their food (which consists of plankton and small species of fish).

▼
An opened-mouthed humpback whale shows its baleen

▶
An orca's impressive teeth are on full display when it opens its mouth



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②

Toothed whales

(also known as odontocetes and including all dolphin and porpoise species)

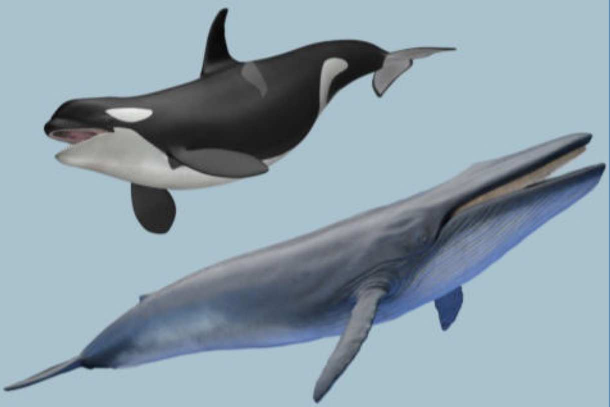
- Odontocetes have teeth and eat larger prey, sometimes including other marine mammals.
- While dolphins have a hooked or curved dorsal fin, porpoises have a more triangular dorsal fin.
- Generally speaking, dolphin bodies are leaner, while porpoises' are a little chunkier.
- Porpoises are usually smaller than other toothed whales and instead of cone-shaped teeth, they have flat, spade-shaped teeth. ◆ AG

DID YOU KNOW?

DISTINGUISHING TRAITS OF BALEEN WHALES AND TOOTHED WHALES:

As a general rule of thumb, baleen whales are larger (except the sperm whale), and slower (except the fin whale, which is known as the "greyhound of the sea") than toothed whales.

Additionally, all baleen whales have two blowholes, while toothed whales only have one.

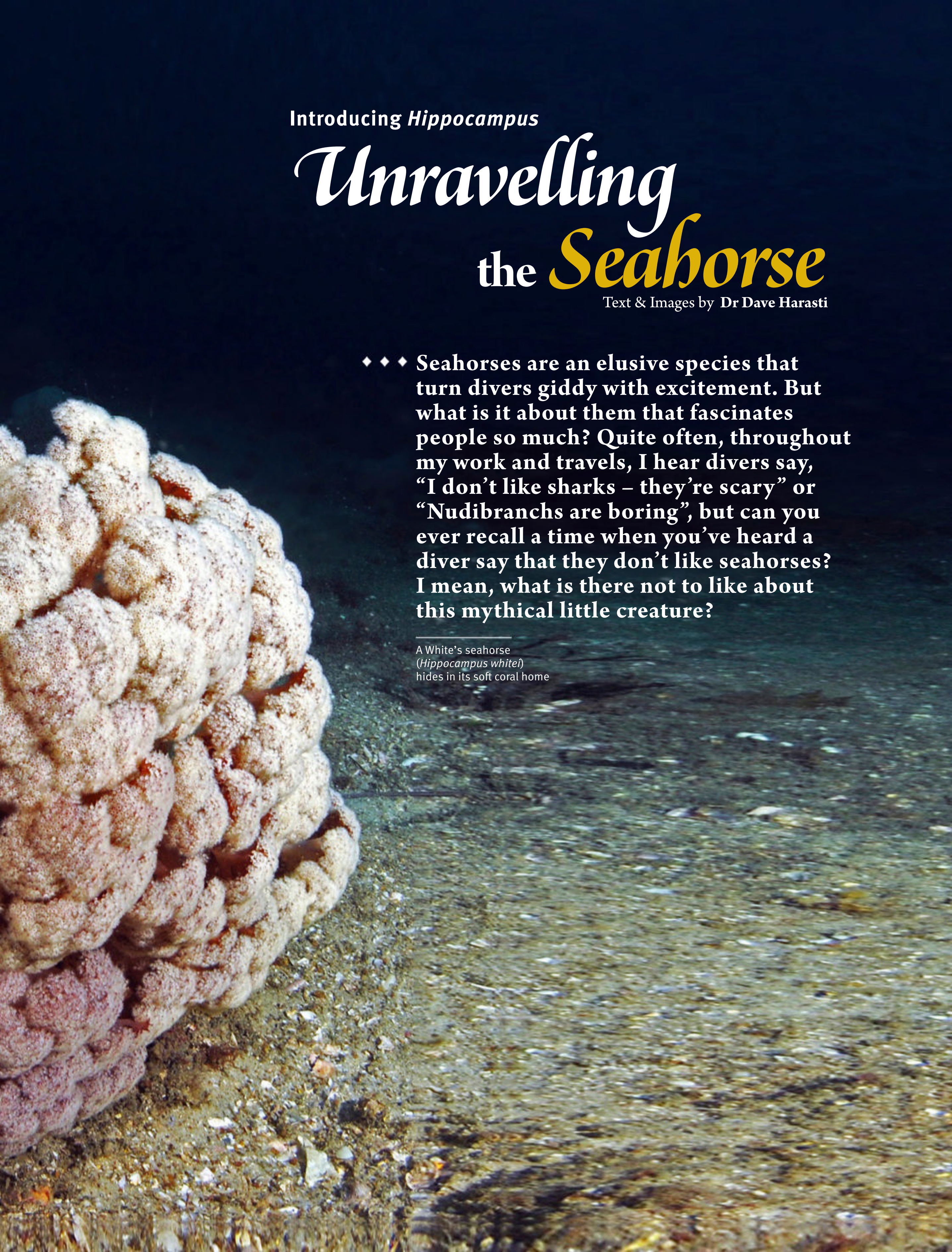


Introducing *Hippocampus*

Unravelling the Seahorse

Text & Images by **Dr Dave Harasti**

◆ ◆ ◆ **Seahorses are an elusive species that turn divers giddy with excitement. But what is it about them that fascinates people so much? Quite often, throughout my work and travels, I hear divers say, "I don't like sharks – they're scary" or "Nudibranchs are boring", but can you ever recall a time when you've heard a diver say that they don't like seahorses? I mean, what is there not to like about this mythical little creature?**



A White's seahorse (*Hippocampus whitei*) hides in its soft coral home

IT'S NOT A HORSE OF COURSE

Seahorses are unusual little marine creatures that belong to the fish family Syngnathidae, which includes seahorses, pipefish, seadragons and pipehorses. They occur throughout the oceans of the world (except in the coldest seas at both poles) and can be found living in a variety of habitats including seagrass meadows, coral reefs, sponge gardens, and even on artificial structures such as jetties.

THE MALES HAVE IT

One of the most fascinating things that make the seahorse so unique is their reproductive biology. In seahorses, it's the male that becomes pregnant, carrying the young in a pouch-like opening. The female deposits her eggs into the male's pouch, which contains sperm, and the pregnancy lasts about two weeks to one month, after which the male gives birth. The number of babies born varies from species to species, but generally a brood size is around 100 to 300 babies. But after giving birth, it's not over yet. This poor male seahorse will generally be impregnated again by a female right after and have to go through the whole process straight away! And not just twice: a besieged male can become pregnant up to eight times during a breeding season! (For some reason, women always seem to like this fact!)

▸
World's oldest living wild seahorse? This White's seahorse, nicknamed "Grandma", was observed at the same site for 5.5 years

▾
The thorny seahorse (*Hippocampus histrix*) is aptly named

DID YOU KNOW?

FALLING IN LOVE

Did you know that seahorses can mate for life? Throughout the year, and especially during the breeding season (which is generally over the summer months), a male and female seahorse will come together in the early morning light, and perform a ritual mating dance for several minutes to cement their bond. During the dance, both seahorses can change colour and they will curl their tails together, slowly turning as they perform their greeting ritual. If the time is right, at the completion of the dance, the female will transfer her eggs to the male.

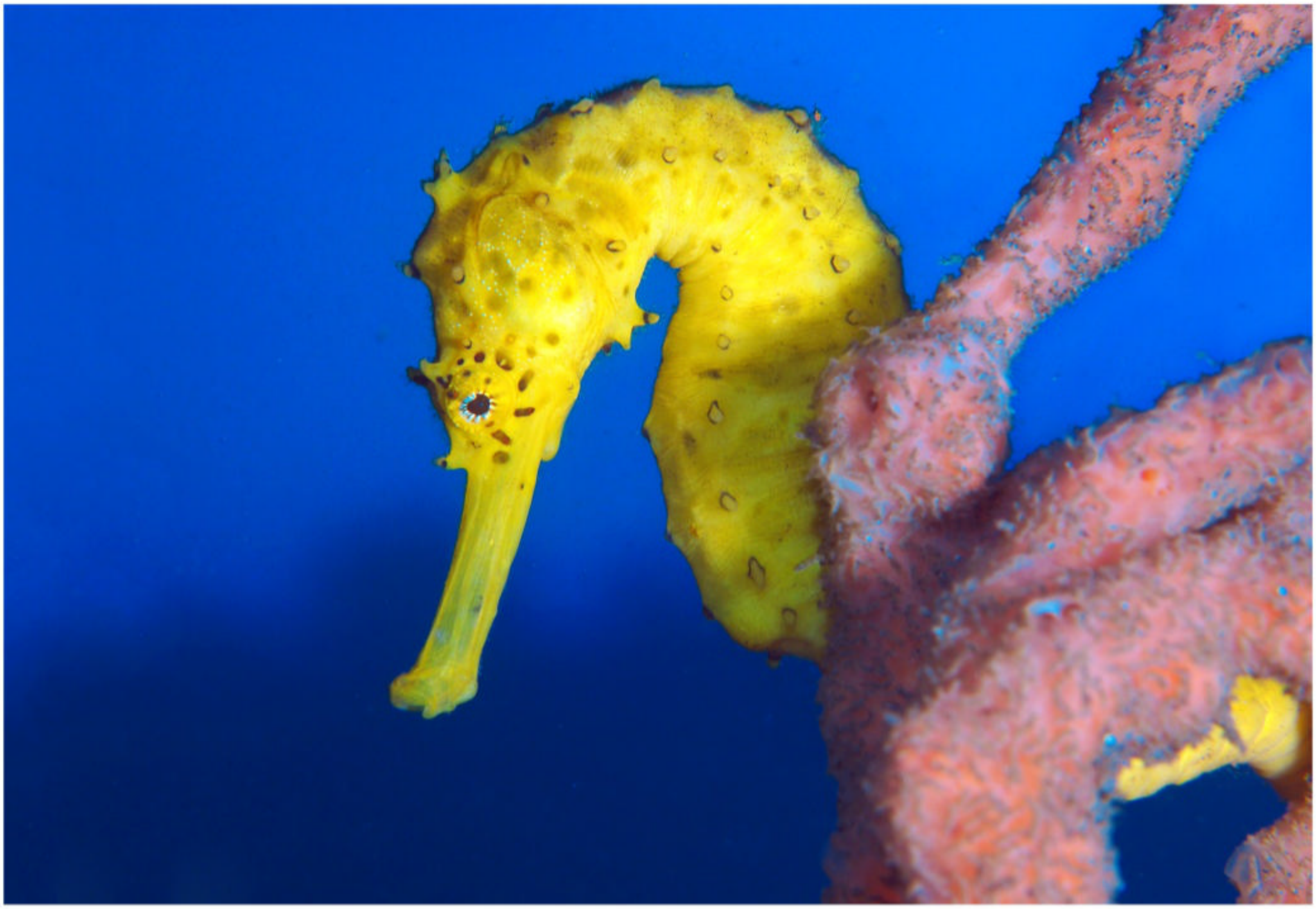
Following birth, the babies are left to fend for themselves as there is no parental care; this is probably because poor dad has just become impregnated again and really doesn't have time to look after all the kids! The survival rate for baby seahorses is considered to be poor and very few survive to adulthood. However, with so many being born during a breeding season, ultimately enough manage to survive to allow more reproduction in the future.

In seahorses, it's the male that becomes pregnant, carrying the young in a pouch-like opening.

MOVE OVER ROMEO AND JULIET...

During my research on the White's seahorse, *Hippocampus whitei*, I had a favourite pair that I nicknamed Goldilocks and Grandpa. I watched these two regularly perform their greeting dance and they were clearly a loved-up, faithful couple that I found together for three years, this being the longest known relationship for a pair of seahorses in the wild.

However, not all seahorses remain faithful, as it has been shown that some species, such as the big-belly seahorse, *Hippocampus abdominalis*, can be rather promiscuous, getting action from several sources.



If we can conserve and protect the habitats that are important to the seahorses, numerous other species will benefit as well. Many other marine species rely on habitats such as seagrasses and coral reefs for feeding, hiding and breeding, and without these habitats the entire marine ecosystem will gradually collapse.

NOW YOU SEE ME

Seahorses are some of the slowest-moving fishes in the ocean, and this makes it almost impossible for them to escape predators. So, the seahorse is a master of camouflage, as it relies on being hidden for survival. They are very adaptable in that they can change their colour to match their surroundings, particularly the holdfast that they have their tail curled around. You will often find an orange seahorse hiding amongst orange sponges, whilst those hiding in seagrass will change their colouration to a more greyish-black to blend in.

◂◂
One of the world's biggest seahorse species, the big-belly seahorse (*Hippocampus abdominalis*) can reach up to 35 centimetres in length

◂
Bargibant's pygmy seahorse (*Hippocampus bargibanti*) is tiny – typically less than two centimetres long!

◂▾
Like many seahorse species, the tiger tail seahorse (*Hippocampus comes*) is threatened by habitat loss

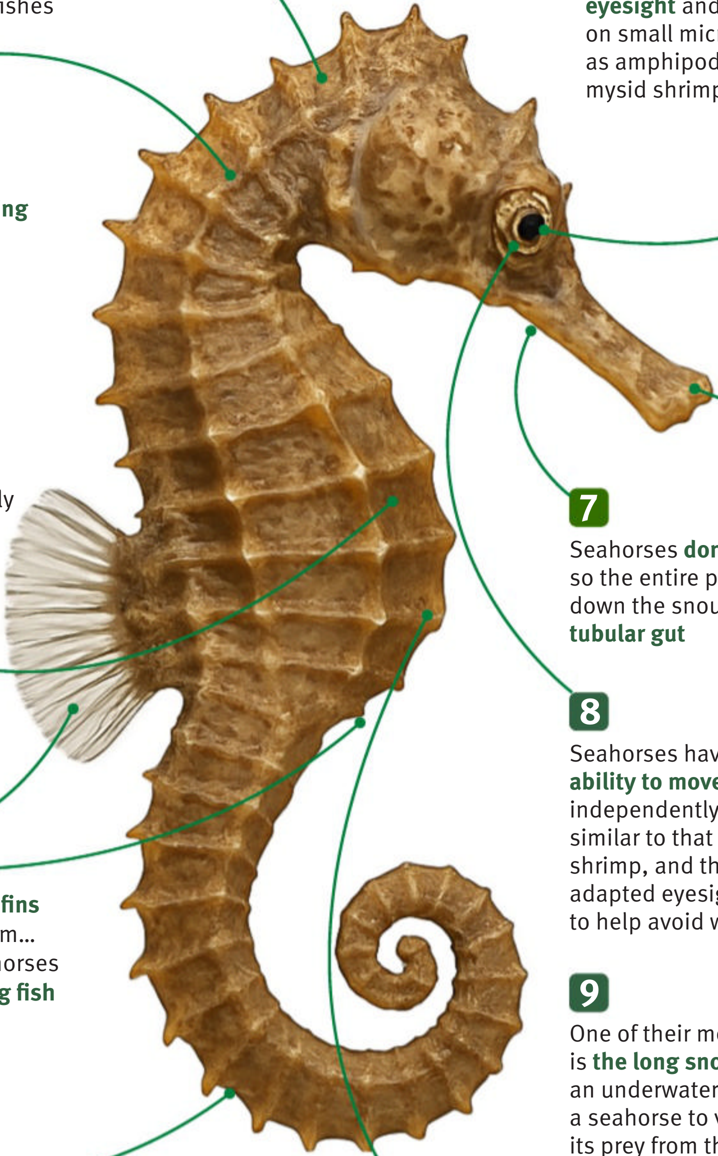
HABITATS ARE THE KEY

Whenever I speak about seahorses to colleagues and students, I always lead with the line, "Save the habitats, save the seahorse". Worldwide, many seahorse species are considered to be under threat through overexploitation for traditional medicines, the aquarium trade, for curios and through loss of essential habitats. It's the loss of their habitats that is of most concern, as once a habitat is lost, such as a mangrove forest, it is almost impossible to bring it back.

One study in Australia proved how habitat loss can have a detrimental impact on local seahorse populations. A dive site known as "Seahorse Gardens" had a large population of White's seahorses, approximately 400 individuals, making it one of the largest known seahorse aggregation sites in the world. Over a five-year period, the site faced considerable human pressure from boats anchoring, faulty moorings and also a large sand movement event that smothered the habitats. By the sixth year, the preferred habitats of the seahorse had declined dramatically, soft corals by 96 percent and sponge gardens by 49 percent. As a result, the number of seahorses remaining on the site was only a measly 10 individuals; a population decline of 97 percent over just six years. A similar finding occurred at a site called "Pipeline", where the seahorse population dropped by 83 percent over the same period, the area having suffered from a similar decline in their preferred habitats.

If we can conserve and protect the habitats that are important to the seahorses, numerous other species will benefit as well. Many other marine species rely on habitats such as seagrasses and coral reefs for feeding, hiding and breeding, and without these habitats the entire marine ecosystem will gradually collapse. Seahorses are charismatic, iconic, easily recognised and well liked. If we can use the seahorse to help promote the conservation of our marine habitats, then the whole marine environment will ultimately reap the benefits. ◆ AG

About Seahorses



1

Seahorses have an **upright body posture** that makes them very different from other fishes

2

The body is constructed from a series of **interlocking bony plates** that provide physical rigidity

3

As they have a **small digestive system**, which processes food quickly, they have to eat constantly to maintain energy

4

Pectoral, **dorsal and anal fins** allow the seahorse to swim… but only very slowly. Seahorses are the **slowest-swimming fish** in the sea

5

They have a **long prehensile tail**. *Prehensile i*s a term used to describe the ability of an animal's tail or limb to grasp. The tail is very important, as a seahorse requires it to grip tightly to a holdfast; a holdfast being the structure (such as a sponge or seagrass) that they live on. If they were not able to hold on, then the seahorse becomes susceptible to the currents and swell of the ocean, as they are poor swimmers

6

Seahorses are ambush predators that detect their prey with **excellent eyesight** and predominantly feed on small micro-crustaceans such as amphipods, copepods and mysid shrimps

7

Seahorses **don't have any teeth**, so the entire prey is vacuumed down the snout into a **short tubular gut**

8

Seahorses have the **unusual ability to move their eyes** independently of each other, similar to that of the mantis shrimp, and they use this well-adapted eyesight for feeding and to help avoid would-be predators

9

One of their most prominent features is **the long snout**, which is basically an underwater vacuum cleaner. It allows a seahorse to voraciously suck up its prey from the water column and surrounding habitats. This is known as "pivot-feeding". **Seahorses have the fastest recorded suction feeding of all fishes**

10

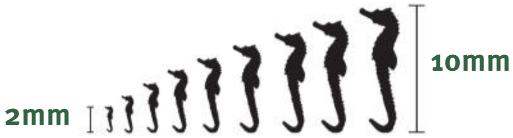
Only the males have a **brood pouch** where they gestate the young

Growing Up

1

BIRTH

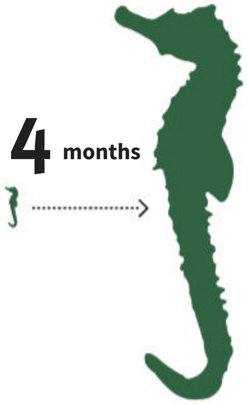
When seahorses are born, they are fully developed and look just like tiny adults. Depending on the species, babies can range in size from two to **10 millimetres**.



2

4 MONTHS

Initially, they grow quite rapidly. In the White's seahorse, it was found that a small **eight-millimetre baby can grow to 80 millimetres and reach maturity in just four months**; this is when it can be determined if the baby has grown into a male or female, through the presence or absence of a pouch.



3

PELAGIC LIFE

Depending on the species, some seahorses will have a pelagic stage where the young will drift in the open water or "raft" on flotsam such as *Sargassum* seaweed.

4

6 MONTHS

Other species (like the White's) have no pelagic stages and the babies will settle in the area where they were born and likely remain in the same location as they mature to adulthood. **After six months, White's are about 100 millimetres long and fully mature, ready to breed.**

5

6 YEARS

The life expectancy of seahorses in the wild varies considerably depending on the size of the species – larger seahorses live longer. The **White's seahorse is known to live for up to six years in the wild**, with the oldest recorded known living wild seahorse being a large female that was appropriately named "Grandma" that was seen on the same site for five-and-a-half years.

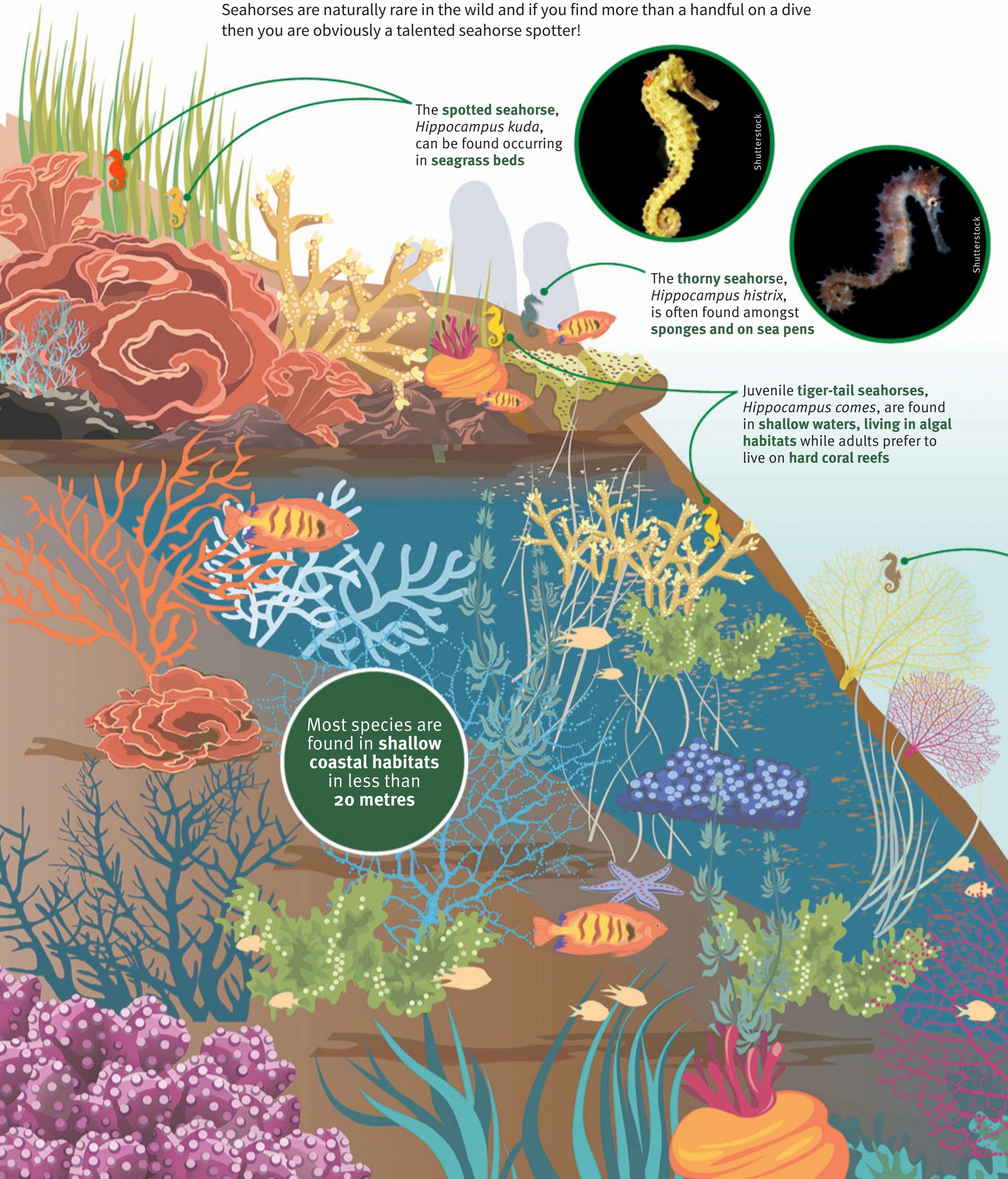
DID YOU KNOW?

KNOW YOUR SEAHORSES

Seahorses can change their colour over a period of just two days, which is one of the reasons why the colour of a seahorse should never be used to identify the species – they can change it on demand!

Where to Look

Some regions are known for having high seahorse diversity, where lots of different species can be found, such as **Indonesia**, the **Philippines** and **northern Australia**. Seahorses are naturally rare in the wild and if you find more than a handful on a dive then you are obviously a talented seahorse spotter!



The **spotted seahorse**, *Hippocampus kuda*, can be found occurring in **seagrass beds**

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The **thorny seahorse**, *Hippocampus histrix*, is often found amongst **sponges and on sea pens**

Shutterstock

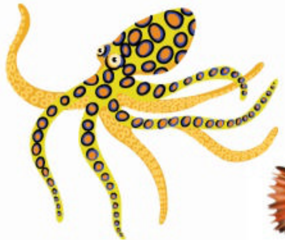
Juvenile **tiger-tail seahorses**, *Hippocampus comes*, are found in **shallow waters, living in algal habitats** while adults prefer to live on **hard coral reefs**

Most species are found in **shallow coastal habitats** in less than **20 metres**

On the Menu

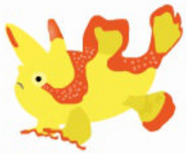
Seahorses' camouflage is critical as there are many species that predate on **seahorses, ranging from penguins to octopuses**, and they have even been **recorded in the stomachs of pelagic fishes** such as **tuna** and **mackerel**. During my research in Nelson Bay, Australia, there were several species observed to feed directly on seahorses including the **blue-ring octopus, frogfish** and **scorpionfish**.

It was found there was a significant correlation between the numbers of these predators and the number of seahorses: As the numbers of predators went up at a site, the abundance of seahorses was found to decline, and vice versa. At sites with very few predators, more seahorses were found to occur.



blue-ring
octopus

scorpionfish



frogfish

Top Tip

If the dive site has lots of predatory species around, then the chance of finding a seahorse is greatly reduced.

Food Chain

82

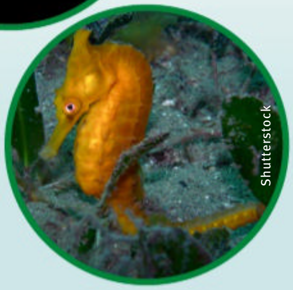
different species eat seahorses

fish

sea turtles

waterbirds

Shutterstock



Shutterstock

The juvenile **White's seahorse,** *Hippocampus whitei,* prefers **small yellow gorgonian fans** to live on, and as they get older, they change habitat and move onto **soft corals and sponges**

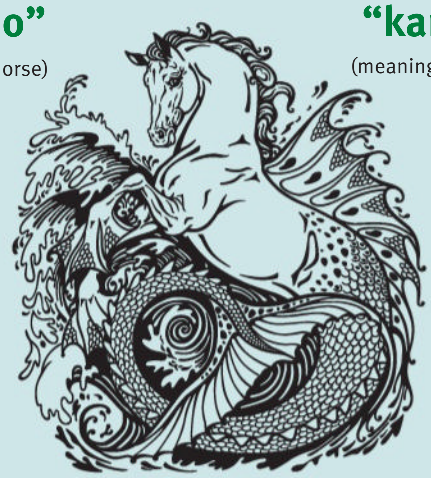
All seahorses belong to the one genus, *Hippocampus*, derived from the Greek:

"hippo"

(meaning horse)

"kampos"

(meaning sea monster)



The head of a horse on the body of a sea monster – the term *Hippocampus* couldn't describe a seahorse more perfectly!

Some species such as the **pygmy seahorses** are known to occur at depths of up to **150 metres**

A Soap Opera in Miniature

Stories from the Stables

Text & Images by **Dr Richard Smith**

◆ ◆ ◆ **Dr Richard Smith's research exposes the private lives of pygmy seahorses**

MINIATURE MYSTERIES

I could never have foreseen what fascinating subjects these diminutive fish would make. Setting out to discover the private lives of pygmy seahorses, I embarked on my doctoral research, studying the biology and conservation of pygmy seahorses, based on what we already knew of the larger seahorses.

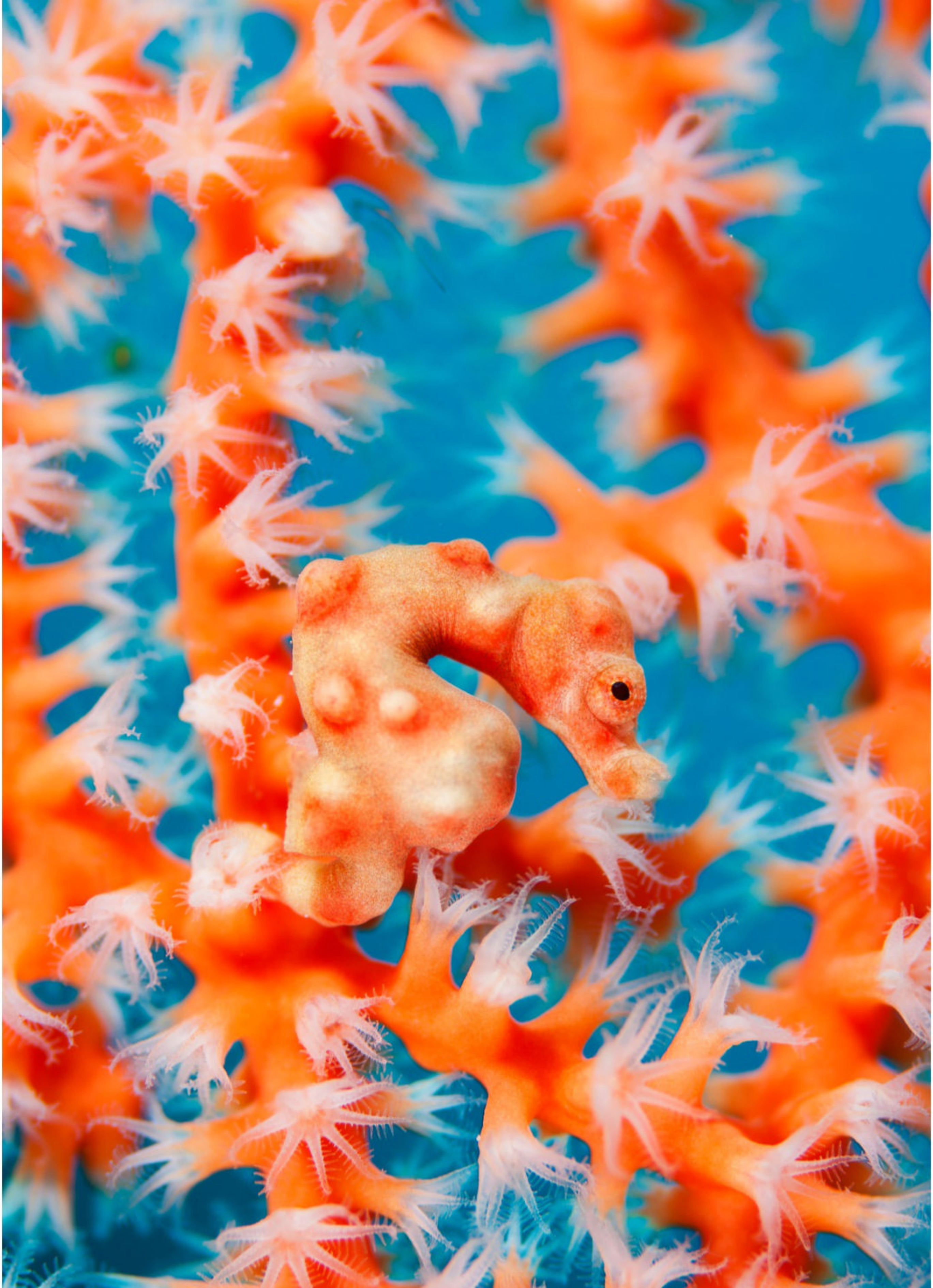
Male pregnancy had already been confirmed from dead specimens, but their natural behaviours on the coral reefs of Southeast Asia remained a mystery. Ultimately, my notes after a research dive read more like an E.L. James novel than scientific records, but I was able to uncover many of these mysterious animals' darkest secrets.

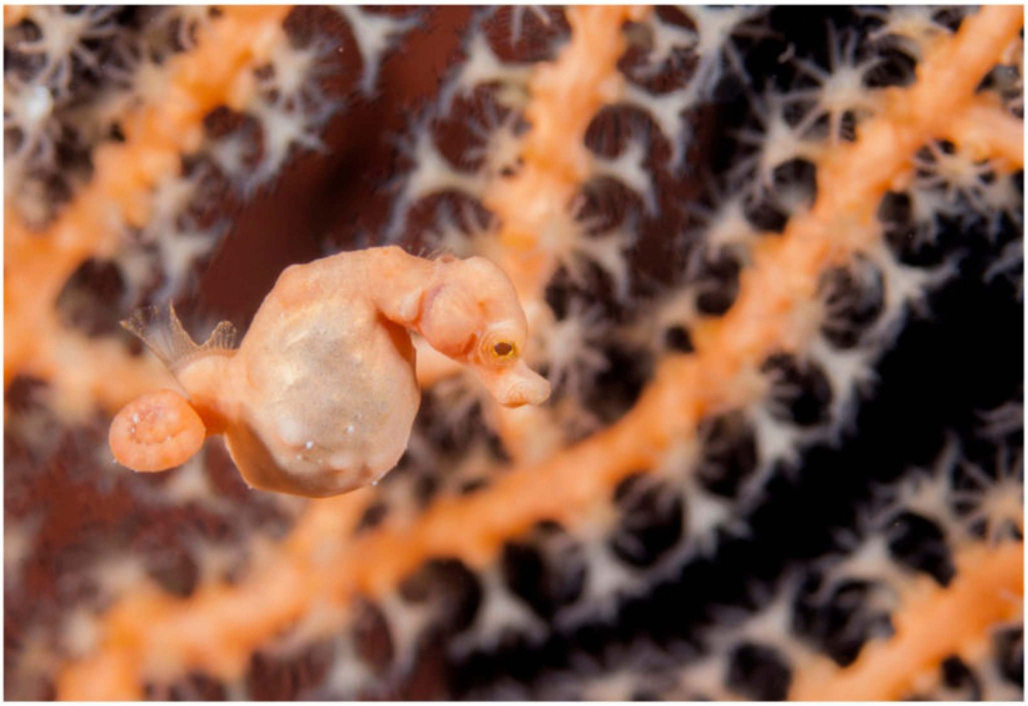
You might not expect pygmy seahorses to have distinct personalities, like characters from a soap opera, but after almost 1,000 research dives watching every last detail of these fish's lives, I can certainly attest to their fascinating and sometimes quirky behaviours.

▸ A Denise's pygmy seahorse on its gorgonian home. The extended tentacles indicate that it has not been disturbed

I have already written about the group of Denise's pygmy seahorses, Tom, Dick, Harry and Josephine, who shared a gorgonian coral on Wakatobi Dive Resort's House Reef. These four showed us how a life trapped together on a gorgonian can take unexpected turns. Josephine shared her amorous attentions with both Tom and Dick whilst poor Harry bided his time for his chance to carry little pygmies of his own. This little "ménage à quatre" sparked plenty of rivalry between the males, but ultimately Tom and Dick shared parental duties in the group.

You might not expect pygmy seahorses to have distinct personalities, but I can certainly attest to their fascinating and sometimes quirky behaviours.

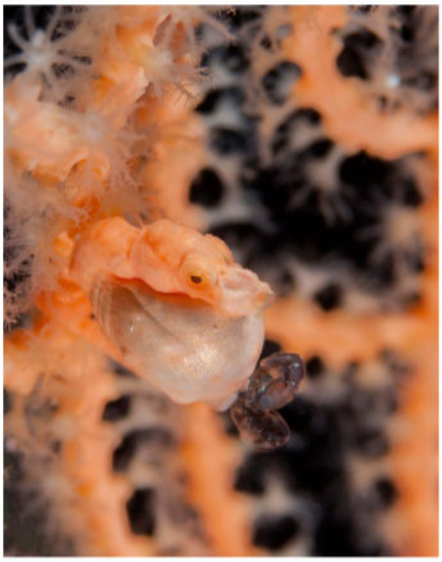


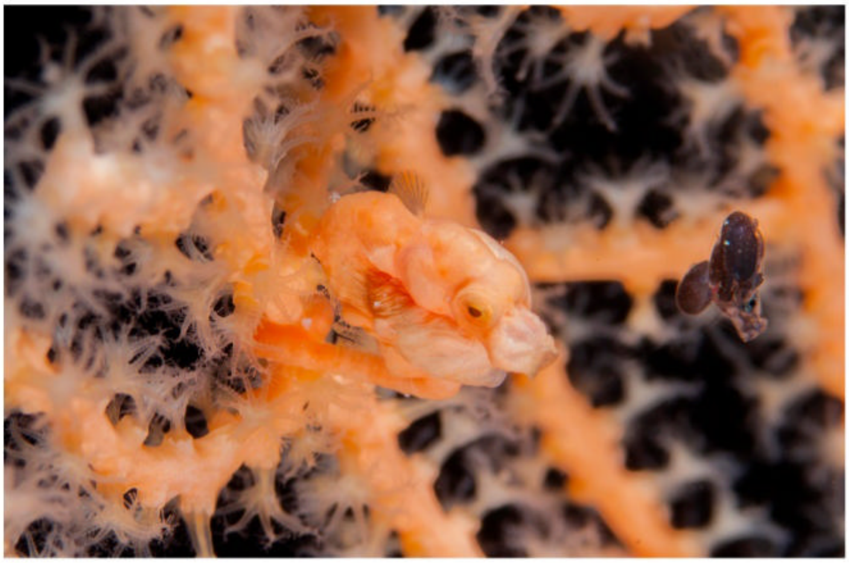


▸
"Tom" post delivery with an empty, deflated pouch, and stretch marks!

▸▸
Almost immediately after delivering the young, the female, in this case "Josephine", impregnates Tom, the male, again

◂
ANTICLOCKWISE FROM TOP LEFT "Tom", a male Denise's pygmy seahorse giving birth. The young are dark in colour, ideal camouflage for their time spent freely floating during their pelagic phase





THE "ROYAL" THREESOME

In hindsight it seems most distasteful, but my research dictated that I next turn my attentions to a female-biased ménage à trois. I had already seen that under the circumstances of a male biased sex ratio, the female (in this case, Josephine) was able to produce clutches of eggs just days apart in order to impregnate two males (Tom and Dick). Subsequently, I was intrigued to find out whether a single male would accept eggs from two females. Luckily, at Wakatobi there is no shortage of pygmies and I soon found a perfect group: Charles, Diana and Camilla.

I spent many hours with the trio, observing and recording their every interaction. I found that Charles and Diana shared a "core area" on one side of the gorgonian. A core area is the term I gave to the area they carried out their social bonding dances, as well as where they mated and slept. They raised several broods together, but all the while Charles was also flirting with Camilla.

Each morning, after dancing with Diana, Charles would leave their core area and swim directly to the other side of gorgonian where Camilla patiently waited in her own core area. Camilla and Charles would carry out the same social bonding dances but they never mated. In the world of pygmy seahorses, it is always best to hedge one's bets.

Unlike the pugnacious males, the two females eschewed violence and the conflict of the male-biased group wasn't seen. Tom, Dick and Harry would regularly attempt to strangle each other with their tails, sometimes resulting in three-strong tussles. The females, on the other hand, were indifferent to each other and much more measured in their behaviours.

PATERNAL DEDICATION

The tension on a male pygmy seahorse's comically puckered face immediately prior to giving birth is unforgettable. As the only male in the animal kingdom to truly undergo this otherwise womanly miracle, I can only imagine how he feels.

The birth certainly seems to involve the expected labour pains. On the several occasions I've been lucky enough to witness it, numerous contractions have been needed to pop the full brood out. Charles had to crunch back and forth for several minutes to free the last of his fry, before being left with terrible stretch marks!

The newly born miniature seahorses only momentarily saw their father before being swept out to sea. They take this opportunity to float in oceanic currents for a few weeks before finding their own gorgonian on which to settle. After it is found, they need only five days to change from their dark, free-floating colouration to one that matches their new gorgonian home in every detail of both colour and surface texture.

Charles' chores, however, were only half complete. He swam right back to the expectant Diana, and after a brief courtship dance they mated. Diana's eggs were fertilised as they passed into his pouch, setting both their minds at rest that no adultery had taken place. The absolute certainty of his fathering all the young explains why seahorse males stand alone amongst all others in their dedication to paternal duties.

HAPPY FAMILIES

Broadening my search further, I found another group of pygmies on Wakatobi's house reef that comprised three pairs. This offered the opportunity to investigate how bonded pairs interacted with each other. Would jealously be a feature of a male pygmy seahorse's behaviour when they were happily partnered? Mapping their home ranges and recording their social interactions, I concluded not.

On a gorgonian as big as a 34-inch LCD screen, individuals spent their entire lives exploring an area in some cases as small as three adjoining Post-it Notes whilst the largest spanned the area of a double page spread in a magazine. Males generally used less space than females, which is probably due to the difficulty of travelling when inflated with young. When happily settled with a single partner, males appeared to pay no attention to other males, with their home ranges often strongly overlapping and without defended territories.

Would jealousy be a feature of a male pygmy seahorse's behaviour when they were happily partnered?

HOME LIFE

Denise's pygmies are more active than you might imagine. Divers usually only stay just long enough to snap a picture, but if you spend a little time watching these tiny fish, you're more than likely to witness them swimming. In all but the strongest currents, they move about every five or six minutes. Hunting for prey to fuel their constant egg production and pregnancy is a full-time pursuit, so they frequently move to pastures new in search of the miniscule crustaceans that live on the surface of gorgonians.

Although small in stature, pygmy seahorses have not been shortchanged in the character department. Their reputation as the stars of the reef go way beyond the aesthetic, and the more you learn about them, the more you appreciate them. Next time you see some pygmies on the reef, why not take a little time to watch the soap opera unfold before your own eyes. ◆ AG

◂
A pair of Pontoh's pygmy seahorses in Sulawesi, Indonesia

▴
A Denise's pygmy seahorse investigates its surroundings, securely attached to its gorgonian holdfast

Divers usually only stay just long enough to snap a picture, but if you spend a little time watching these tiny fish, you're more than likely to witness them swimming.

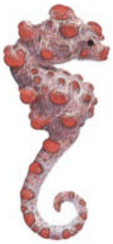
The Eight Pygmy Seahorse Species

Since the start of the **21st century, seven of the eight species of pygmy seahorse** have been scientifically described.

YEAR OF DISCOVERY

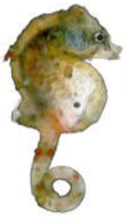
1970

Bargibant's seahorse
(*Hippocampus bargibanti*)

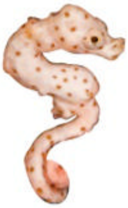


2003

Coleman's pygmy seahorse
(*Hippocampus colemani*)

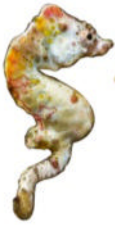


Denise's pygmy seahorse
(*Hippocampus denise*)

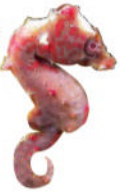


2008

Pontoh's pygmy seahorse
(*Hippocampus pontohi*)

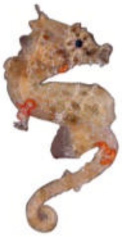


Severn's pygmy seahorse
(*Hippocampus severnsi*)

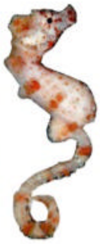


2009

Satomi's pygmy seahorse
(*Hippocampus satomiae*)

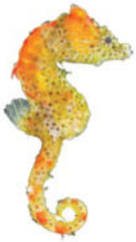


Walea pygmy seahorse
(*Hippocampus waleananus*)



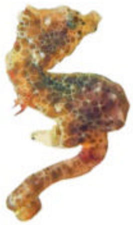
2018

Japanese pygmy seahorse
(*Hippocampus japapigu*)



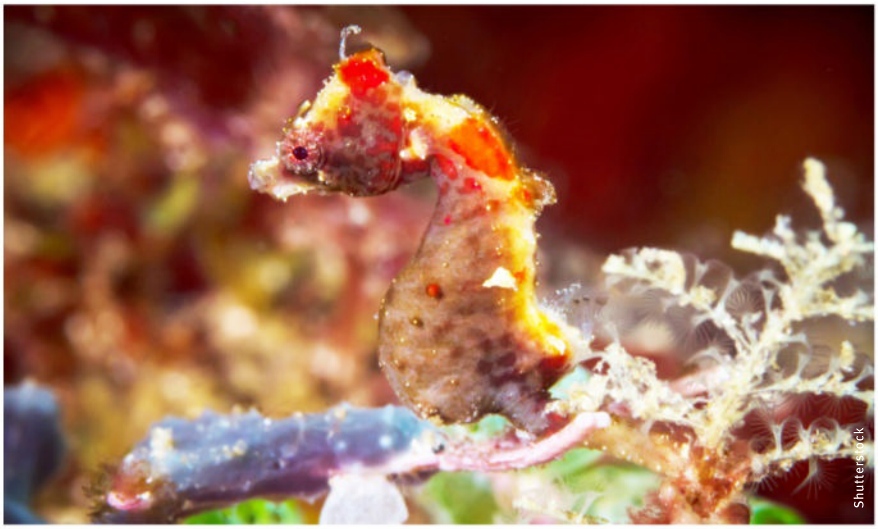
2020

Sodwana pygmy seahorse
(*Hippocampus nalu*)



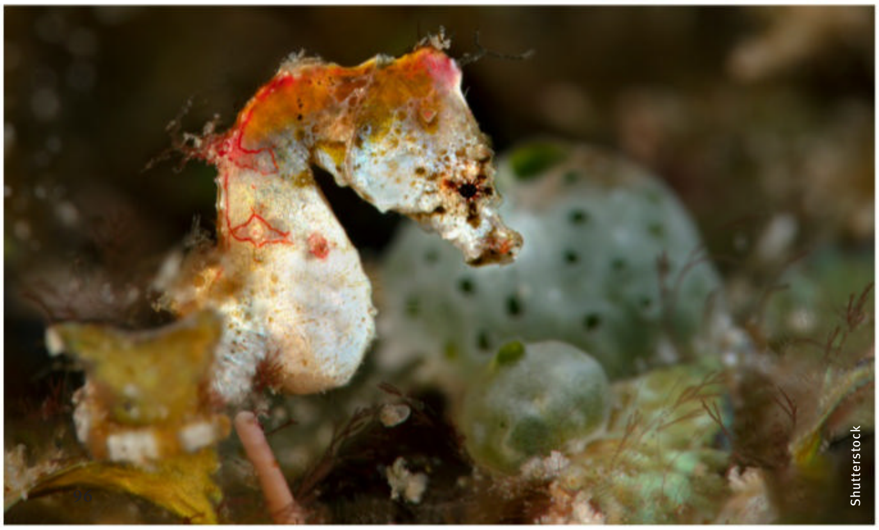
THE PONTOH'S/SEVERN'S CONTROVERSY

In 2008, Pontoh's and Severn's pygmies were given the names, ***Hippocampus pontohi*** and ***Hippocampus severnsi***, respectively. However, genetic evidence has since shown that these two actually represent two colour forms of one species.



▸
Severn's pygmy seahorse
(*Hippocampus severnsi*)

Shutterstock



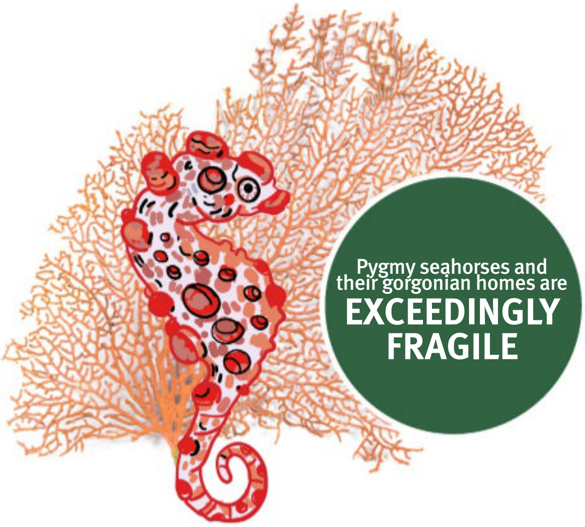
The name **"Severn's pygmy seahorse" (*Hippocampus severnsi*)** is being dropped and **"Pontoh's pygmy seahorse" (*Hippocampus pontohi*)** will be retained in to the future.

◂
Pontoh's pygmy seahorse
(*Hippocampus pontohi*)

Shutterstock

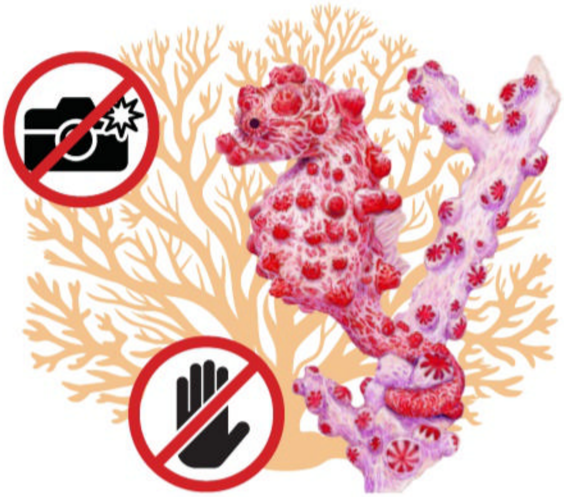
Photographing Pygmy Seahorses

Pygmy seahorses and their gorgonian homes are exceedingly fragile. **Gorgonians can live for over 100 years**, **but are easily damaged**. My research showed that a third of all contacts made during pygmy seahorse photography were made with the gorgonian. This can quickly degrade it, making it susceptible to disease and render the pygmies homeless.



Pygmy seahorses and their gorgonian homes are **EXCEEDINGLY FRAGILE**

I also found that bright light from torches and **camera focus lights were extremely disturbing to pygmies.**

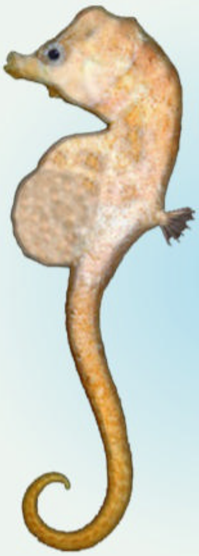


As you'd expect, **neither the pygmy nor the gorgonian should be touched or manipulated** to make a better photo. By sticking to these few tips, we can help keep these fascinating fish happy and healthy.

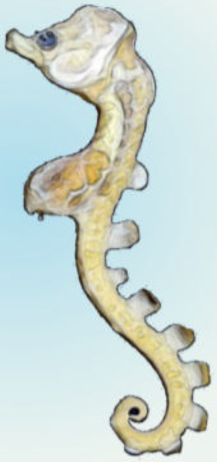
DID YOU KNOW?

DWARVES AND PYGMIES

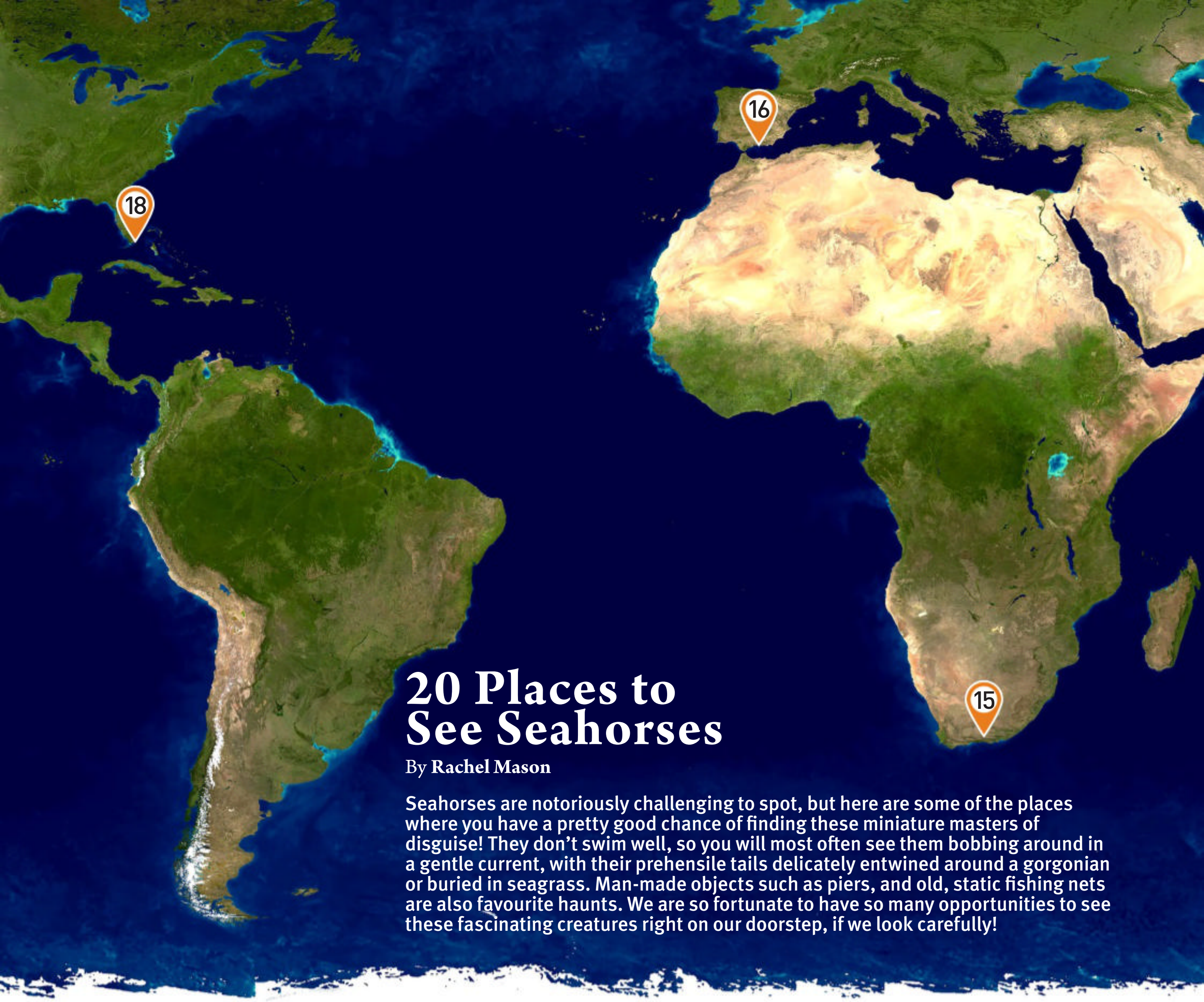
Did you know that there are other tiny seahorses besides pygmies? True pygmy seahorses have several morphological features that distinguish them from other species, but there are also other small seahorses that lack these features. Some, such as the **bullneck** and **paradoxical seahorse**, are known only from specimens brought up in trawlers' nets, **measuring just five and six centimetres, respectiely**. Another, the Red Sea soft coral seahorse, has only been sighted very few times and lives on soft corals and gorgonians exclusively in the Red Sea. These dwarf seahorses are identical to the large species in every way except their size. They have paired rather than single gill openings and their brood pouch is located on the tail, rather than within the trunk.



bullneck seahorse
(*Hippocampus Minotaur*)



paradoxical seahorse
(*Hippocampus paradoxus*)



20 Places to See Seahorses

By **Rachel Mason**

Seahorses are notoriously challenging to spot, but here are some of the places where you have a pretty good chance of finding these miniature masters of disguise! They don't swim well, so you will most often see them bobbing around in a gentle current, with their prehensile tails delicately entwined around a gorgonian or buried in seagrass. Man-made objects such as piers, and old, static fishing nets are also favourite haunts. We are so fortunate to have so many opportunities to see these fascinating creatures right on our doorstep, if we look carefully!

1. MELBOURNE, AUSTRALIA

DIVE HERE
Port Phillip Bay, Blairgowrie Pier, Rye Pier, Rosebud
LOOK FOR
Big-belly and short-head seahorses
BEST TIME
Year round; warmest time is January

2. SYDNEY, AUSTRALIA

DIVE HERE
Sydney Harbour, Chowder Bay
LOOK FOR
Big-belly & White's seahorses
BEST TIME
Year round; December to March is warmest

3. WELLINGTON, NEW ZEALAND

DIVE HERE
Wellington Harbour
LOOK FOR
Big-belly seahorses
BEST TIME
Summer months, December to March

4. DUMAGUETE, DAUIN, PHILIPPINES

DIVE HERE
Pyramids, Sarah's Place, Rockpile, Pura Vida House Reef
LOOK FOR
Pygmy, thorny & zebra-snout seahorses
BEST TIME
October to June

5. WHALE ISLAND, VIETNAM

DIVE HERE
Hon Ong, Beach Shore Dive
LOOK FOR
Spotted & spiny seahorsess
BEST TIME
May to September

6. BATANGAS, PHILIPPINES

DIVE HERE
Basura, Secret Bay
LOOK FOR
Pygmy, tiger-tail, thorny & great seahorses
BEST TIME
November to June

7. EAST TIMOR

DIVE HERE
Bob's Rock, Roda Reef, Tasi Tolu
LOOK FOR
Pygmy, thorny & spotted seahorses
BEST TIME
Year round

8. MERGUI ARCHIPELAGO, MYANMAR

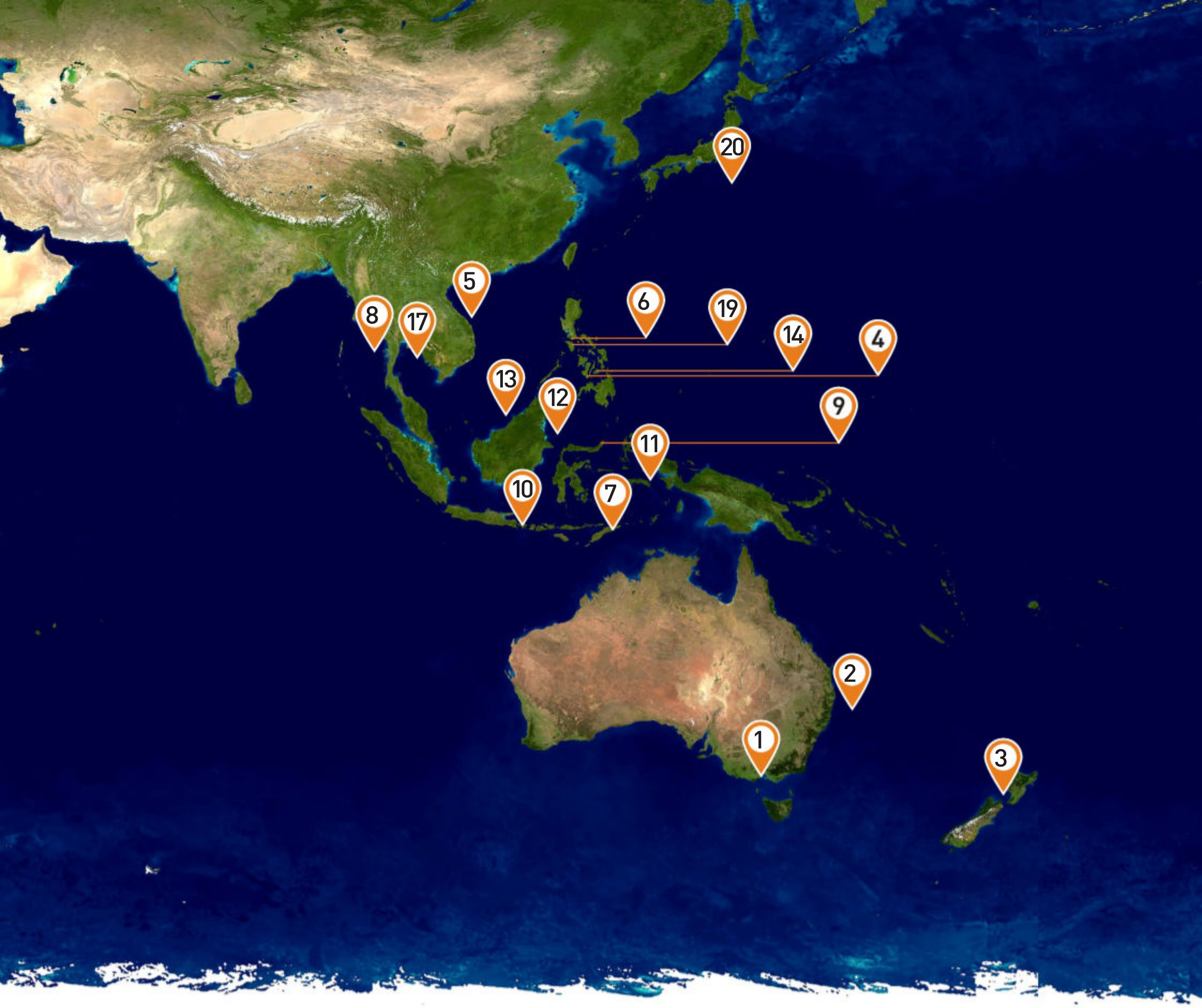
DIVE HERE
High Rock, Rocky Peaks, Shark Cave
LOOK FOR
Tiger-tail seahorses
BEST TIME
October to May

9. LEMBEH STRAIT, INDONESIA

DIVE HERE
Angel's Window, Police Pier, Hairball
LOOK FOR
Pygmy, thorny, spotted & hedgehog seahorses
BEST TIME
Year round

10. BALI, INDONESIA

DIVE HERE
USS *Liberty*, Secret Bay (Gilimanuk)
LOOK FOR
Pygmy, spotted & thorny seahorses
BEST TIME
Year round; best from July to October



11. RAJA AMPAT, INDONESIA

DIVE HERE

Cross Wreck/Critters Corner, Mike's Point (Misool)

LOOK FOR

Pygmy seahorses

BEST TIME

March to November

12. MABUL/SIPADAN, MALAYSIA

DIVE HERE

Crocodile Avenue (Mabul), Mid Reef (Sipadan)

LOOK FOR

Pygmy, spotted & thorny seahorses

BEST TIME

Year round

13. LAYANG LAYANG, MALAYSIA

DIVE HERE

D Wall

LOOK FOR

Pygmy seahorses

BEST TIME

March to August

14. BOHOL, CABILAO ISLAND, PHILIPPINES

DIVE HERE

Lighthouse, Current View Point, Gorgonia Wall, Lighthouse 2

LOOK FOR

Pygmy & thorny seahorses

BEST TIME

November to May

15. SOUTH AFRICA

DIVE HERE

Knysna, Keurbooms & Swartvlei Estuaries

LOOK FOR

Knysna (Cape) seahorses

BEST TIME

December and January

16. PORTUGAL

DIVE HERE

Rio Formosa

LOOK FOR

Short-snouted & long-snouted seahorses

BEST TIME

April to September

17. PATTAYA, THAILAND

DIVE HERE

Koh Larn (aka Seahorse City), Koh Pai

LOOK FOR

Hedgehog & tiger-tail seahorses

BEST TIME

December to March

18. FLORIDA, USA

DIVE HERE

Blue Heron Bridge

LOOK FOR

Slender & dwarf seahorses

BEST TIME

Year round; slack tide

19. PUERTO GALERA, PHILIPPINES

DIVE HERE

The Boulders, Batangas Channel, Verde Island

LOOK FOR

Pygmy, thorny, zebra-snout, great & spotted seahorses

BEST TIME

Year round, especially April to November

20. HACHIJO JIMA, JAPAN

DIVE HERE

Nazumado

LOOK FOR

Japanese pygmy seahorses

BEST TIME

July to November

Cerulean Colossus

Text by **Katie Brooks**

Nana Trangratanawong

A little introduction to the world's biggest fish

The whale shark, *Rhincodon typus*, is a slow-moving filter feeding shark and the largest extant fish species

The whale shark is perhaps one of the great mysteries of our ocean; the biggest fish in the sea and yet it was not described by science until 1828. Though estimated to have existed for over 60 million years, however, only a meagre 320 records of its occurrence existed until 1986, mainly noting that the adults of this species weigh tens of tonnes, yet only feed upon microscopic plankton, while recent years have brought with them research programmes, tourism, plenty more sightings and a lot more science. Today, many questions still remain. How did such a large animal escape our notice for so long? And how is it that now, with hundreds of papers published, there are still great holes in our knowledge of this species?

Let's start with what we do know. Firstly, there is the prestigious title of the biggest fish in the sea. The largest reported whale shark to date was documented in Taiwanese fishery in 1987 at a giant 20 metres and weighing in at a massive 34 tonnes! With the capacity to reach such a great size, it has been estimated that these animals might live as long as 150 years. Their confusing name often leads many to think of them as whales, not sharks, but the whale part of the name is perhaps more of a nod to its great size, as well as the ecological similarities they share with these mammals, roaming the oceans in search of their planktonic food.

We also know now that these giants are usually found in all tropical and warm temperate seas, usually, with a few exceptions, between the latitudes of 30°N and 30°S. Whale shark sightings have been reported in both oceanic and coastal waters, with much of what we now know and understand about these giant fish being gleaned from seasonal and relatively predictable coastal aggregations of these animals that form at various locations around the world.

Until recently, much of what we had learnt about whale sharks has come from coastal aggregation sites, where, as the whale sharks feed, often close to the water's surface, studies and research programmes have been able to document, count, identify, measure and record not only the sharks, but the various environmental factors that seem to draw them in.

Christian Vizl

The whale shark inhabits all tropical and warm-temperate seas

Phillip Colla

In some locations, long-term research is showing that more that 50 percent of the sharks seen each year have been seen in previous years, suggesting a certain degree of site fidelity, at least on a seasonal basis. Somewhat conversely, satellite tags have been deployed and have recorded these creatures moving many thousands of kilometres from these sites and diving to depths of over 1,900 metres.

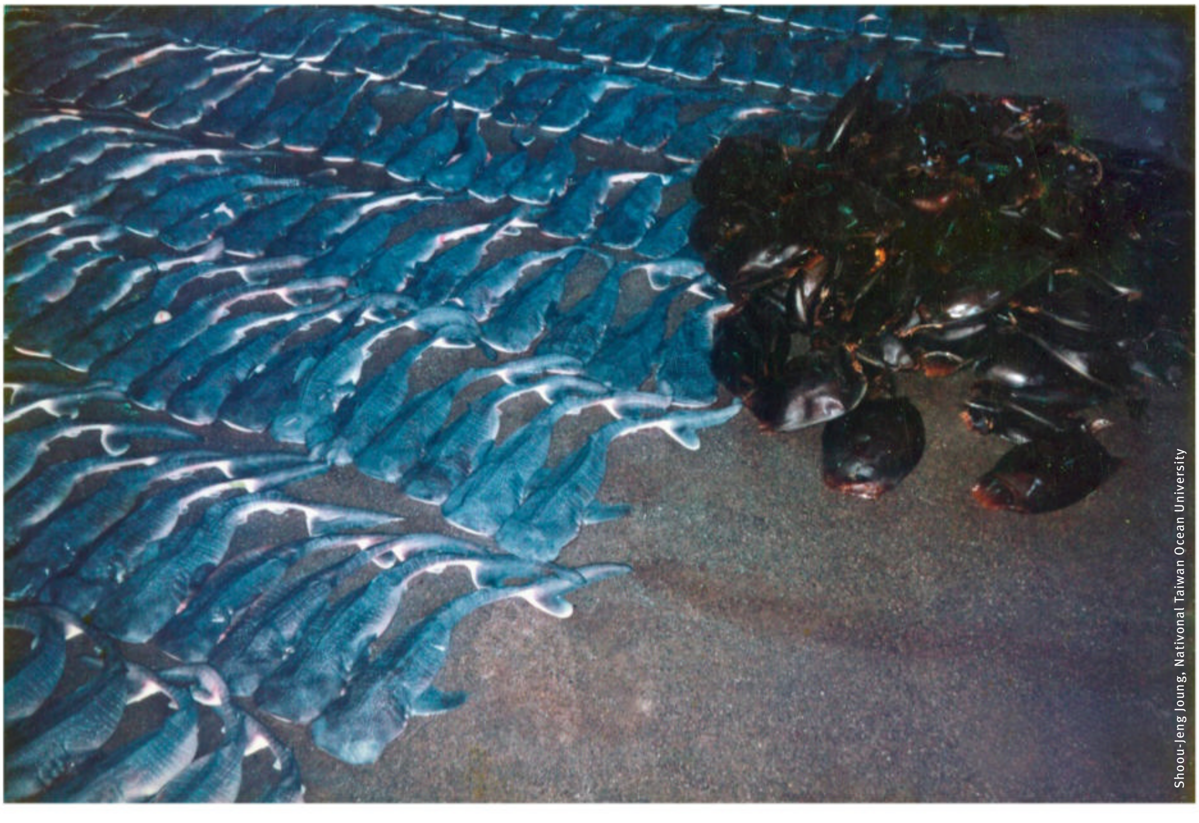
We now understand that these animals can make enormous journeys and yet, there is little evidence to prove or even suggest that any of the animals seen during an aggregation at one site are moving to or feeding at any of the other aggregation sites. Relying too much upon these coastal aggregations to inform our knowledge of this species is also a risky strategy and is somewhat limiting and potentially misleading, as many of the coastal aggregations have proven to be dominated by immature males of around four to eight metres in length, leaving large gaps in our knowledge about the whereabouts of large adults, females and the juveniles.

While the predictable occurrence of whale sharks and their habit of swimming and feeding close to the surface has led, in some places, to dedicated research programmes and ecotourism initiatives, which have done much to further knowledge and inform conservation, these same traits have also placed the whale shark in a precarious position. Many of the early records of this species were collated by a biology professor from the US, Eugene Willis Gudger, who recorded several instances of collisions between boats and whale sharks (incidentally, despite his contribution to whale shark science, he never once saw or swam with a live whale shark).

It is likely in the age of faster ships crossing our oceans in greater numbers that such instances still occur, but without record. It has certainly become clear during the study of whale shark aggregations that many bear the scars of too close an encounter with a boat. Boats aside, fishing, both targeted and bycatch, has had a huge impact on these animals. In the early 1990s, a targeted fishery for these animals began as their flesh came to be considered a delicacy known as “tofu snack” especially in the Taiwanese restaurant trade.

◂
Whale sharks
migrate to feed and
possibly to breed

▾
Mass killing: Babies
from a pregnant whale
shark caught and killed



Shoou-Jeng Joung, Nativonal Taiwan Ocean University

This increased demand caused the rapid expansion of a number of fisheries, all of which proved to be shortlived after massive declines were seen in whale shark numbers just a few years after they commenced, as might be expected in a long lived, late maturing, slow growing species, unable to replenish population numbers at a rate not even close to that which they were being removed. This rapid decline in numbers led to fishery bans everywhere, including Taiwan in 2008. Unfortunately, despite the fishing bans, local and international level protection and monitoring now in place for these animals, there is still evidence in some regions to suggest that fishing, or at least finning, continues and a recent reassessment of their status for the IUCN's Red List of Threatened Species still maintains as "Endangered".

Perhaps one of the greatest mysteries of this shark is how it reproduces. To this day, gestation periods, mating and pupping grounds remain unknown and until recently, any information on pregnancy was also lacking. The capture of a pregnant female that landed in the Chen-Kung fish market in Taiwan in 1995 changed all this. The female, who measured 10.6 metres in length, proved that these animals are aplacental viviparous (where eggs are retained inside the mother's uterus until they are ready to hatch) with some 304 embryos inside her twin uteri, the largest litter recorded in any shark species.

These pups were in various stages of development, ranging from 48–64 centimetres in size. The smaller embryos were in egg cases with external yolk sacs while the larger embryos (58–64 centimetres) lacked both the egg case and the nutritious yolk sac, indicating they were ready to be released, 15 live young were found inside the mother; two were in fact kept in aquariums in Taiwan and Japan. The pup in the Taiwanese aquarium proved its viability, rapidly growing and surviving for almost six months.

Guy Stevens

Nana Trangratanawong

To be pregnant with so many pups poses more scientific questions than it perhaps answers, but maybe the most interesting question is that of paternity. In order to assess this, one genetic study took samples from 29 of this litter across the size classes and found that all had the same father, suggesting very strongly indeed that a single male sired the entire litter, causing scientists to reject the perhaps more logical theory that different sharks were the fathers of the pups at the different stages of development. Potentially, this could suggest long term pairing, however, this behaviour has never been observed in sharks.

There's also the possibility of embryonic diapause, where the eggs are fertilised and then maintained in a dormant state before implanting, but as seen in previously observed cases, the eggs all implant and subsequently develop at the same rate. Maybe and probably the most likely explanation, the female whale shark is capable of storing sperm, which has been seen in other shark species that include both blue sharks and gummy sharks.

Whatever the case, based on the evidence of this single female's huge litter size, there is a chance female whale sharks might only ever mate once, so perhaps the mating grounds, or the opportunity of scientists ever witnessing mating behaviour might forever remain a mystery.

Perhaps one of the greatest mysteries of this shark is how it reproduces. To this day, gestation periods, mating and pupping grounds remain unknown and until recently, any information on pregnancy was also lacking.

◂
The largest confirmed individual had a length of 12.65 metres and a weight of more than 21.5 metric tonnes; there are unconfirmed reports of considerably larger whale sharks

▴
The whale shark is an active feeder, targeting concentrations of plankton or fish

New fields of study are always opening up and the open ocean is one area that remains as yet relatively understudied, especially with respect to whale sharks.

Aside from this large litter, very little evidence of small whale sharks exists. In fact, a mere 33 accounts of whale sharks smaller than 1.5 metres have left a whole section of the whale shark's lives unaccounted for by science. Geographically, these small sharks have been broadly distributed, found in the Pacific, Indian and Atlantic Oceans. It's also worth mentioning that one of these neonates, a 94-centimetre pup found in India, still had an egg sac attached, suggesting it was not ready to be pupped. Another, a 46-centimetre pup found in the Philippines, had fully absorbed its egg sac suggesting that it was just about to birth. These two records both conflict with what was learnt in Taiwan in the 90s and only proves how little we know and understand with the scarcity of information surrounding this issue.

As for the large sharks, well, they remain somewhat mysterious, too. However, large females have been reported from the southern Sea of Cortez, the Galápagos and the Philippines. Motivated by the endless questions that this species poses, scientists are always searching for new and innovative ways to find out more. New fields of study are always opening up and the open ocean is one area that remains as yet relatively understudied, especially with respect to whale sharks. New projects though are beginning to tackle the question of whale sharks within this complex and vast offshore environment. Perhaps such projects will begin to answer some of our remaining questions about these enigmatic ocean wanderers. ◆ AG

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SPOTTING THE DIFFERENCE!

Over time, we have learnt that a whale shark's spots are completely unique to individuals. Moreover, they do not change significantly over time. In this respect, this can be compared to a human fingerprint. Scientists now have software that helps automate the process of matching these spot patterns, allowing greater insights into the lives of these sharks. With such technology available, scientists, can quite quickly assess whether or not the same sharks are frequenting the same sites day after day, month after month and even year after year. Collecting this data over long periods of time allows the estimation of populations at specific sites and collecting this data over broad geographic scales will hopefully give us an insight of how these populations all fit together. For more information about the global whale shark database, check *www.whaleshark.org*.

KATIE LEE-BROOKS saw her first whale shark back in 2006 whilst working as a volunteer monitoring coral populations in the Seychelles. As it turned out, whale sharks were to change the course of Katie's life as she walked away from her career as a buyer into a new life as a marine biologist.

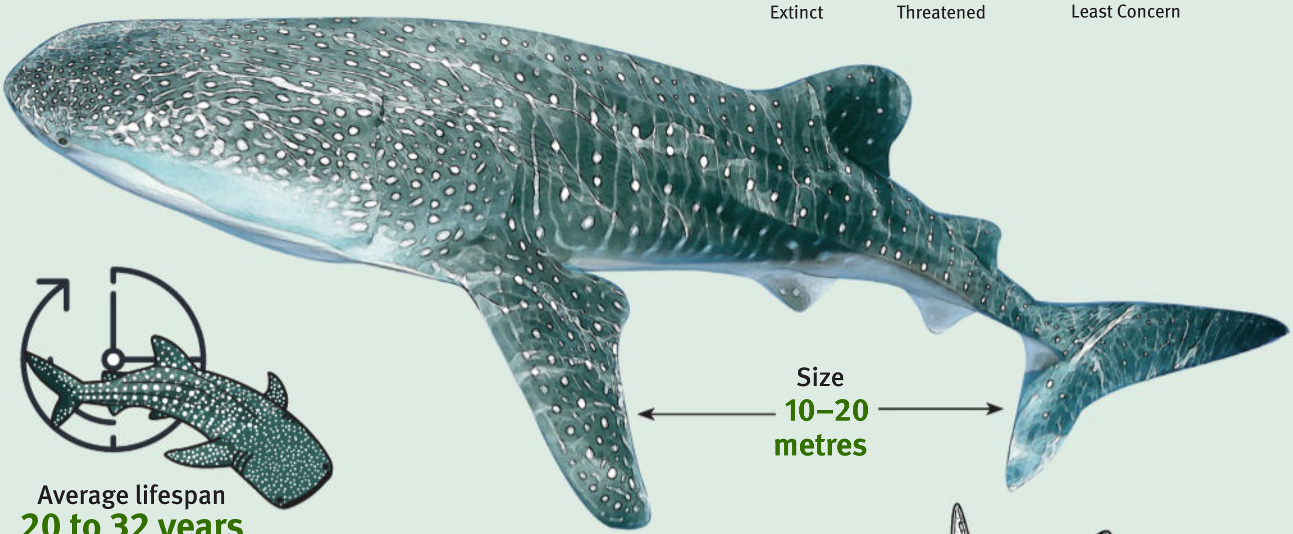
Whale Shark

Scientific Name	: *Rhincodon typus*
Subspecies	: *R. typus*

CONSERVATION STATUS

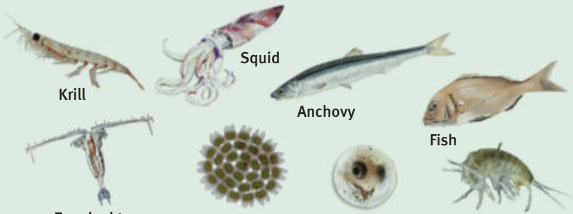
EX EW CR **EN** VU CD NT LC

Extinct — Threatened — Least Concern

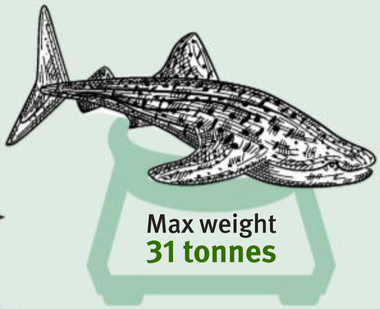


Size
10–20 metres

Average lifespan
20 to 32 years



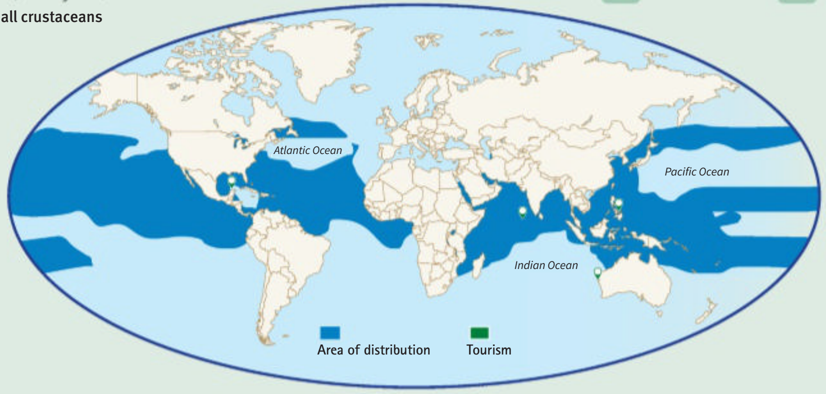
Newborn pups measure
58–64 centimetres



Max weight
31 tonnes

Diet

One of only three known filter feeding species, the whale shark survives on a diet of planktonic and nektonic prey. It feeds by swimming with its huge mouth open through nutrient rich water and capturing large quantities of **zooplankton** and **phytoplankton**, **krill**, **roe**, **small crustaceans**, **squid** and **fish** through a filtration process



Habitat

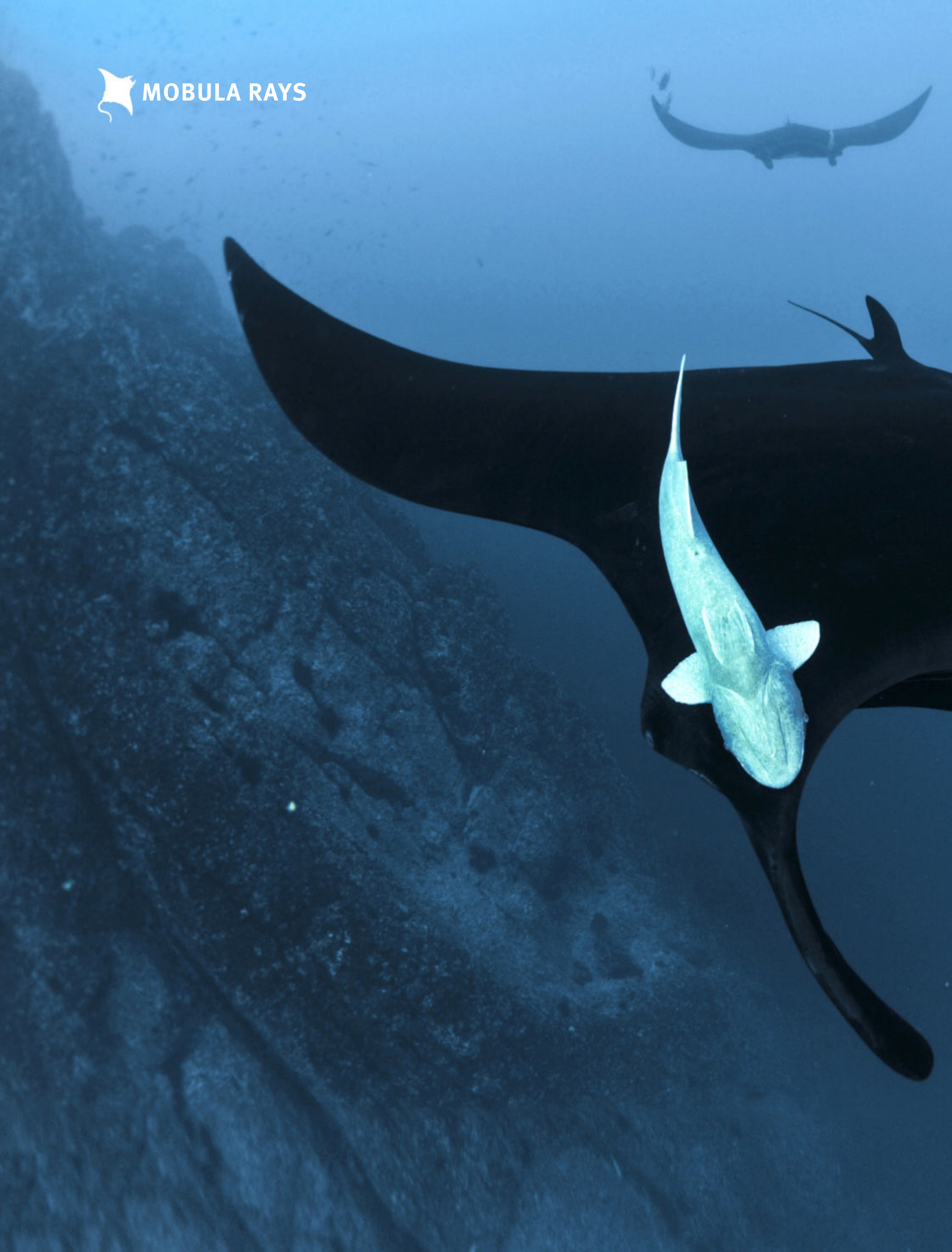
Typically seen offshore, whale sharks have been found closer to land, entering lagoons, coral atolls and river mouths. This species is capable of diving to **depths of at least 1,928 metres**, though they are most often seen at the surface. **Seasonal aggregations occur at several coastal sites**, where hundreds of individuals gather to take advantage of a reliable food source

Geographical Distribution

Whale sharks are a primarily pelagic species found in all tropical and warm temperate seas except the Mediterranean. The core distribution is between **30 degrees north** and **35 degrees south** and is likely temperature limited as they are rarely sighted in surface **temperatures below 21°C**. Genetic results indicate that two major subpopulations exist, one in the **Atlantic Ocean** and the other in the **Indo–Pacific**

Tourism

Despite its immense size, the whale shark poses no threat to humans. Encounters are possible while scuba diving, but the best way to swim with these gentle giants is to snorkel with them at the surface. One of the best places to do this is in **Isla Mujeres, Mexico**, where hundreds of individuals gather seasonally to feed on the eggs of spawning bonito. Other well-known aggregations occur in **Australia**, the **Philippines** and the **Maldives**

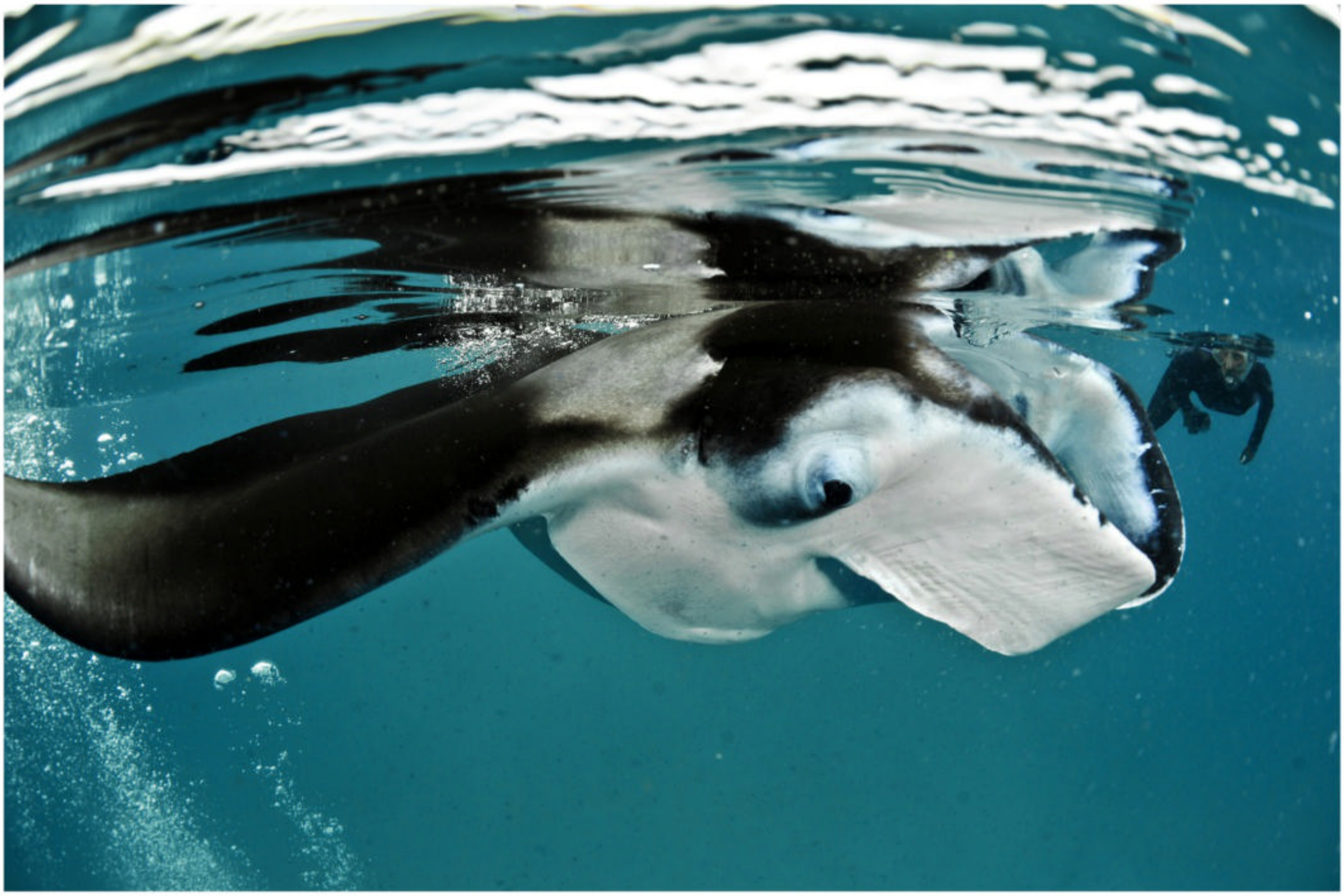


Ocean Giants

Text & Images by **Guy Stevens**

Understanding the enigmatic mantas and other mobula rays

Two giant black morph oceanic manta rays (*Mobula birostris*) circle Roca Partida, a remote seamount in the Revillagigedos Islands in Mexico



▲ The eyes of the manta ray bulge out from the very sides of their head, creating an excellent field of vision from which to spot danger

► A surface feeding reef manta ray

Mantas and other mobula rays are fascinating and captivating creatures. Giants of their kind, they range throughout the tropical and subtropical oceans of the world. Born into a life of perpetual motion they must keep swimming to survive. Driven forward by powerful beats of their wing-like pectoral fins, they travel the oceans in search of food and the urge to mate.

Despite the fact that manta rays in particular are hugely fascinating to divers and snorkellers around the world, it has only been in the last 20 years that widespread research into the mysteries and complexities of these animals' lives has begun in earnest. This article details the fundamentals of what we know today about these fascinating creatures.

FAMILY HISTORY AND GLOBAL DISTRIBUTION

Like all cartilaginous elasmobranchs, mobula rays have a skeleton comprised of flexible, fibrous and light cartilage as opposed to the dense bony skeletons of the vast majority of all other fishes. A close relative of all sharks and rays, mobulas must constantly keep swimming forward in order to ensure a steady supply of oxygen rich water flows over their gills; they can never stop to sleep or rest on the seabed.

The first rays appeared in the oceans approximately 170 million years ago. Radiating from shark-like ancestors, they adapted to a more benthic mode of life. The flattened body shape of rays is essentially a squashed version of the archetypal shark, with internal physiology very similar to that of their shark cousins. It was from these bottom dwelling rays that the pelagic mantas and smaller mobulas (traditionally called devil rays) evolved, taking to the open water around 20 to 25 million years ago.

The defining feature of the Mobulidae family is that they are all filter feeders, using their mouths and modified gill rakers to strain plankton and small fishes from the water. In general, devil rays are much smaller than mantas and can be distinguished by morphological differences in their mouths and cephalic fins ("head fins"). Devil rays have a bottom jaw which is undercut, so that when their mouths are closed, the edge of the lower jaw rests much further back than the upper, whereas the jaws of manta rays are aligned evenly.

The other differentiating anatomical feature of devil rays is the shape of their cephalic fins, which when rolled up look like horns projecting off their heads, hence the name. The primary function of these fins is to help funnel planktonic food into the gaping mouths of the rays when they are feeding. Unfurled, the devil ray's cephalic fins are just small flaps, but in the mantas, these fins unravel to form much larger paddle-like structures, which touch in the centre to form a complete funnel around the manta's mouth. These fins are used by the mantas when feeding to help them channel their planktonic prey into their mouths.

The Mobulidae family contains 10 species of plankton and fish eating rays (see table). Within this family, there is just one genus: *Mobula*. Historically, the family contained two genera, *Manta* and *Mobula*, but mitochondrial and nuclear DNA sequencing later revealed that they are actually very closely related. Taxonomists now consider mantas to be a part of the *Mobula* genus, and "manta ray" and "devil ray" are the common names used to refer to the two groups of *Mobula* species. Very little is known about the devil rays which, unlike the mantas, are generally very shy towards divers, making it hard for scientists to observe their natural behaviour in the wild. Like mantas, they are found throughout tropical and subtropical oceans. Sometimes aggregating in vast shoals of many hundreds, they come together possibly to feed or to seek safety in numbers.

These aggregations may also occur more frequently at breeding times and it is not uncommon to encounter these large groups attracting attention at the surface as the rays leap several metres out of the water. There are currently seven described species of devil rays.

There are three recognised manta species: *Mobula birostris* (the giant oceanic manta), *Mobula alfredi* (the reef manta), and *Mobula yarae* (the Atlantic manta). The first two species emerged from a 2009 study that identified the smaller *Mobula alfredi* found in the Indo-Pacific and tropical East Atlantic, and the larger *Mobula birostris* found throughout tropical, subtropical and warm temperate oceans. The 2009 work flagged the likely existence of a third Atlantic manta species, and mitochondrial and nuclear DNA testing finally resulted in the formal identification of *Mobula yarae* in 2025. The Atlantic manta occurs throughout the Atlantic Ocean, from the northeastern United States to southeastern Brazil, including the Gulf of Mexico and the Caribbean islands.

REEF MANTA RAY

The reef manta is smaller than the oceanic manta ray, with an average disc-width of 3–3.5 metres (9–11.5 feet). These reef mantas live quite different lives to their giant counterparts, occurring in the shallow waters along the coastal reefs of continents and around remote oceanic islands and archipelagos. These mantas are more commonly encountered by divers and snorkellers and tend to be highly social. They are often resident to a specific home range, migrating around this area as they follow changes in the seasonal abundances of their planktonic food source, or are driven by the urge to find a mate and reproduce.

Reef mantas commonly frequent the same sites year after year for many decades, allowing researchers to gather in-depth data on the population as a whole and follow more closely the lives of specific individuals as they grow, reproduce and migrate.

GIANT OCEANIC MANTA RAY

As its name suggests, the giant oceanic manta ray is generally larger than its smaller reef resident relatives, with average disc-widths of around four to five metres (13–16.5 feet) and in extremely large specimens, possibly exceeding seven metres (23 feet). Large oceanic mantas might weigh up to two tonnes (4,440 pounds). The literature on these species also cites the presence of a non-functional spine at the base of the tail, which is not present in their reef manta counterparts, as a defining anatomical feature.

While the range of these two species overlaps, the giant mantas appear to be much more transitory in nature, wandering large distances across open oceans. The oceanic mantas are most frequently sighted along productive coastlines with regular upwelling, at oceanic island groups, offshore pinnacles and seamounts.

Oceanic mantas also venture into the slightly cooler waters of the higher latitudes, with reported sightings as far afield as 31°N (South Carolina, USA) and 36°S (North Island, New Zealand). While divers and snorkellers still encounter this species, their elusive and migratory nature means that we know much less about these giants than their smaller reef-dwelling relatives.

LIFE HISTORY

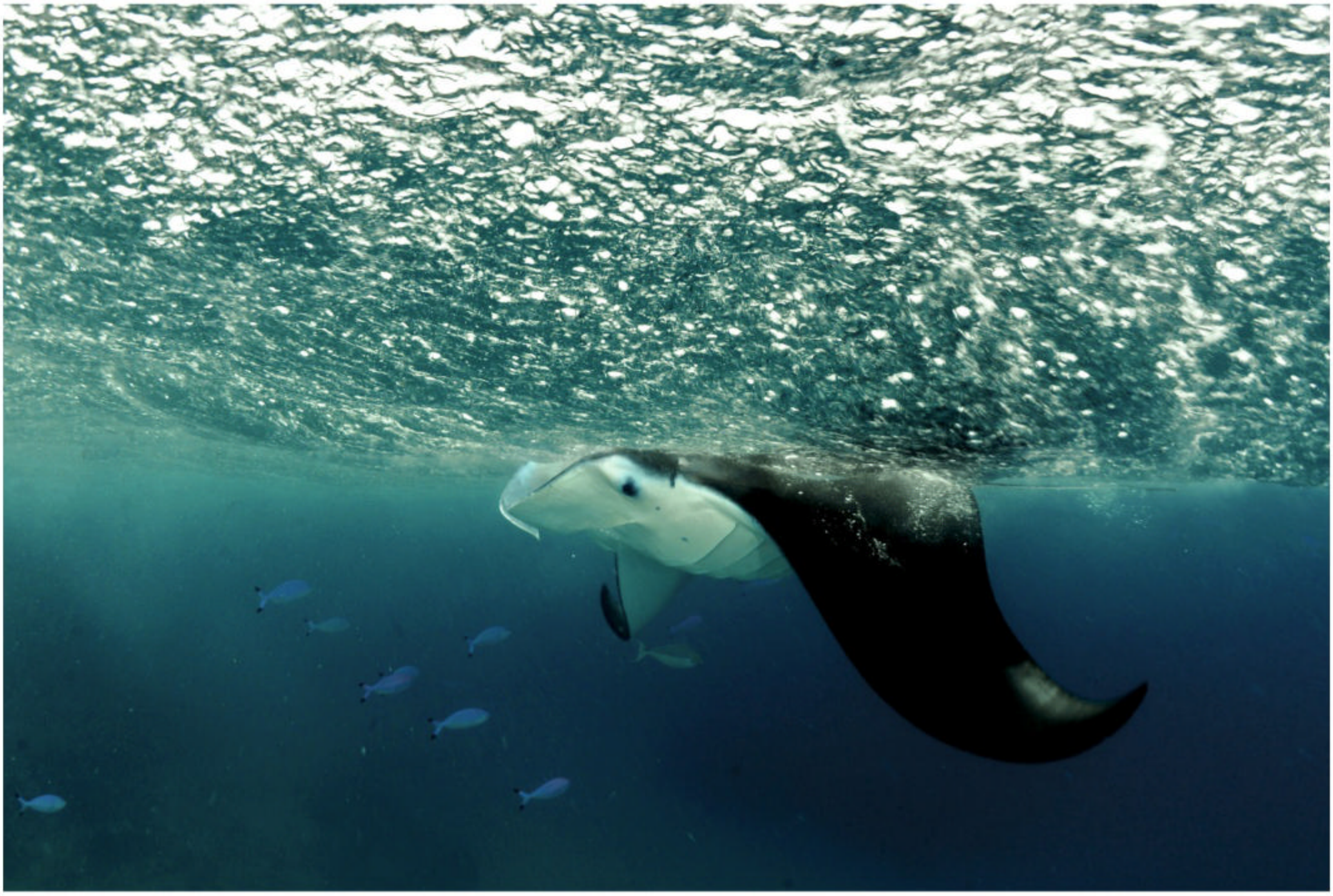
Like all elasmobranchs, but unlike nearly all the other fish in the sea, manta rays reproduce through internal fertilisation, which means male and female must come together to mate. They give birth to live young that are miniature versions of their parents; ready to fend for themselves, they are completely independent from birth. Courtship rituals and actual mating events are relatively infrequently observed and the only known documentation of a live birth of a manta ray in the wild is a series of photographs captured by photographer Roberto Fabbri in the Red Sea in 1967. Many gaps still remain in our knowledge of the sexual lives of these fantastic creatures, and what little we do know is based on very little hard scientific data.

Mantas are ovoviviparous, meaning that once they have mated, the fertilised egg grows within the female's uterus until it has developed into a fully functioning manta pup. In aquariums, the time between mating and pupping has been observed to take around one year. Mantas usually give birth to a single pup, but occasionally two developing embryos have been recorded inside a pregnant female during autopsies.

At birth, mantas measure around 1.5–2 metres from wingtip to wingtip. It is believed that mantas become sexually mature at around 10–15 years of age, possibly even longer for females.

Courtship in mantas can last days or even weeks and is an intricate process led by the female. The males compete to mate with the female, following her around the reef in what is known as a mating train; as many as 30 males may line up behind a single female.

A black morph reef manta hovers over a cleaning station in Raja Ampat



Courtship in mantas can last days or even weeks and is an intricate process led by the female. The males compete to mate with the female, following her around the reef in what is known as a mating train; as many as 30 males may line up behind a single female. Watching a mating train of mantas is an enthralling experience, with the female leading the males as she races, twists, turns and dives around the reef with each male following her every move. In doing this, the female tests the fitness of the males as they try to keep up with her and gain the first place in the train.

At the end of this process, the female selects a single male and the two mate as a pair, belly to belly in the midwater, the male biting down on the female's left wing to secure them together. These bites leave permanent mating scars on the ends of the female's pectoral fins where the wingtip is gripped by the male's muscular pharynx at the back of his mouth. Just like humans, manta rays exhibit signs of lateralisation, with nearly all observed mating scars occurring on the left-hand side of the females, suggesting the males favour this side of their body.

Currently, it is not known how often females give birth, but the latest research suggest birth rates average around one pup for each mature female every two to five years. This extremely slow rate of reproduction, coupled with the long gestation period, late maturity age and small litter size, makes manta rays highly vulnerable to exploitation.

Research would indicate that mantas probably live for around 50 and possibly up to 100 years. However, until scientists have been studying these animals for several more decades, we are unlikely be able to answer this question more accurately.

▲
A reef manta feeds on plankton-rich water at the surface during a storm in the Maldives

▶
A mass aggregation of cyclone feeding manta rays at Hanifaru Bay Marine Protected Area in the Maldives

FEEDING AND CLEANING

Mobula rays are known as filter feeders and this term most accurately describes the way in which these animals are able to consume their microscopic food. Ingeniously designed, mobula rays are efficient and expert foragers, roaming the seas and oceans in search of food. Upon finding an abundant food patch, the rays transform into feeding machines, unfurling their horn-like cephalic fins from either side of their giant mouths to act as a funnel, the once flattened body and mouth becomes a giant black hole with wings, powering the ray through the water as countless litres of water flow in through the mouth and stream out over the five pairs of gill slits that line the throat of the animal.

Plankton and small fishes (depending on the ray species) flowing over these gills is sieved out of the water and trapped by feathered gill rakers. Once the rakers have netted a mouthful of food, the ray closes its mouth and coughs, back-flushing the trapped food from the gills into the back of its mouth before swallowing its mouthful of highly nutritional prey.

As well as their physiological feeding adaptations, mobula rays also employ a variety of behavioural feeding strategies and techniques to maximise the amount of food they can funnel into their mouths at each feeding event. Manta rays barrel roll through dense patches of plankton, while the speedy fish-eating devil rays lunge at their faster moving prey with powerful beats of their pectoral fins.

As well as their physiological feeding adaptations, the rays also employ a variety of behavioural feeding strategies and techniques to maximise the amount of food they can funnel into their mouths at each feeding event.

Manta rays have no hands or appendages with which to clean or groom themselves, so instead, they visit specific locations on a reef to have their bodies cleaned of parasites and dead tissue by small fish known as cleaners.

Unlike the devil rays, which often feed more on larger prey items, the plankton-eating mantas spend a lot of time swimming around with their mouths wide open. As a result, particles of food and debris become lodged in their gills, creating an unwanted build-up of dental detritus. Manta rays have no hands or appendages with which to clean or groom themselves, so instead, they visit specific locations on a reef to have their bodies cleaned of parasites and dead tissue by small fish known as cleaners.

These cleaner fish are commonly wrasses, although other fish families, such as angelfishes and butterflyfishes, also perform this task. This relationship is mutually beneficial to both the manta rays and the cleaner fish, which gets their dinner served up on a giant flapping plate.

BRAINY BUNCH

With brains that are disproportionately large when compared to their body size, the devil ray has a brain weight that is more comparable to that of a similar sized mammal – much larger than the brain of fish of similar body sizes. Furthermore, manta rays also possess a network of blood vessels that surround their braincase, presumed to help keep this organ warmer than the surrounding tissue. Manta rays have been known to make very deep dives, where sea temperatures decrease rapidly.

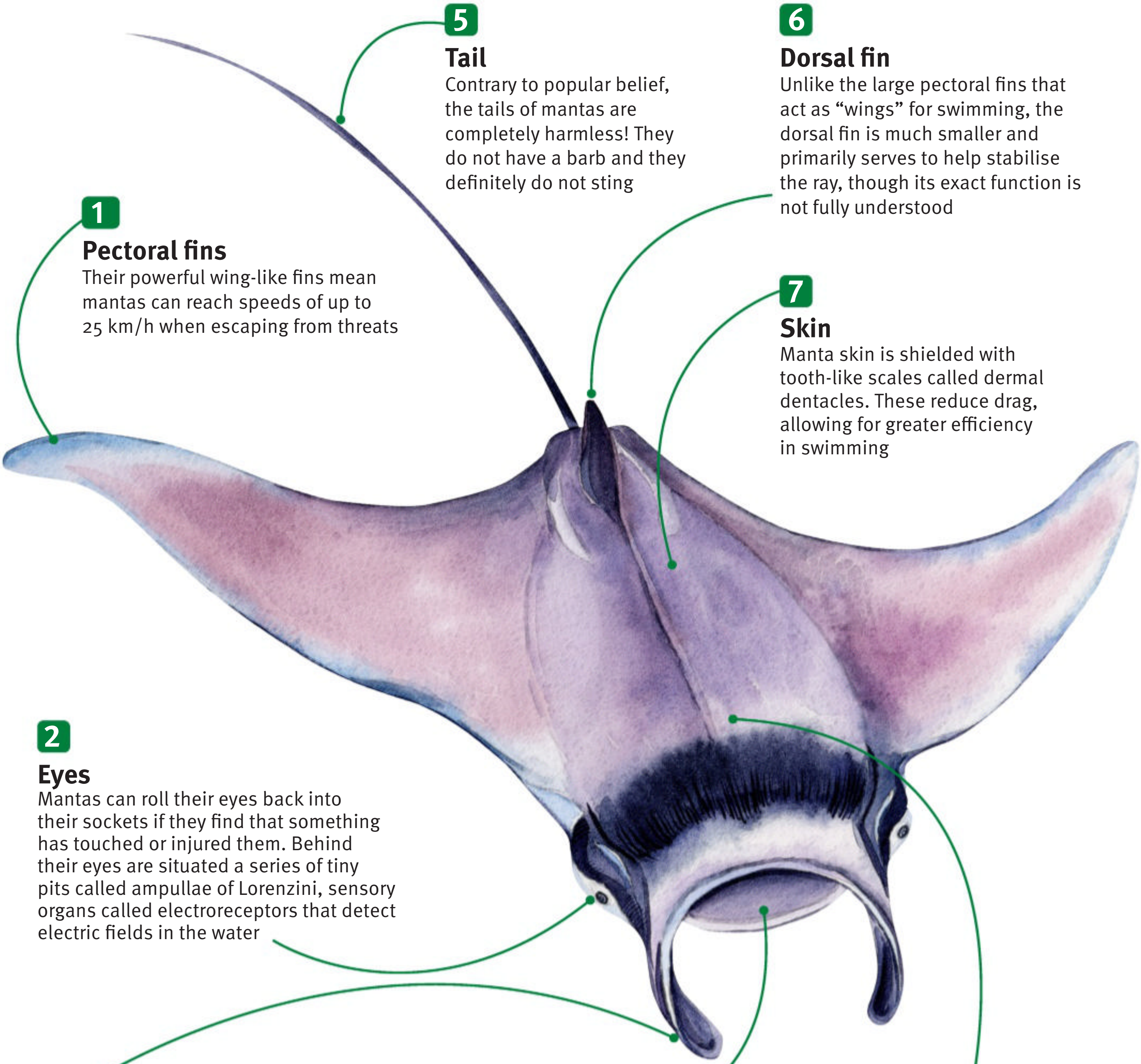
This system of blood vessels is therefore likely to be important in helping to keep these animals' brains functioning effectively even in these colder temperatures. Mammals are also able to thermoregulate, indeed, it is one of the major reasons for their success as a group. Whether or not these similarities between the brain physiology of manta rays and mammals is an indication of similar function and intelligence is not known, but certainly manta rays high degree of social interactions and curiosity towards humans would suggest there is a lot more going on behind those captivating eyes than is currently assumed.

In the last 20 years, scientists have made a good start at uncovering the secret lives of devil rays, however, we are only just beginning to glimpse below the surface. Much still remains to be found out about even the basics of their biology, and with the largest brain-to-body ratio of all the world's fishes, there is much still to understand about their intelligence, curiosity and social interactions. Learning more about these species is vital to being able to provide them with effective protection, ensuring their persistence in years to come. ◆ AG

◀
Leading the males on a mating train around the reef, the larger female trails a chain of eager males all vying for position closest to the female

DR GUY STEVENS is the Chief Executive and Founder of the Manta Trust. He has spent the last 20 years studying mobulids all over the world and is one of the foremost experts on these species. He founded the Maldives Manta Conservation Programme in 2005 and after 11 years of research, he completed his PhD on the world's largest population of reef manta rays at the end of 2016. His conservation efforts in the Maldives have led to the creation of several marine protected areas at key manta aggregation sites, most notably at Hanifaru Bay. Internationally, he is part of a team which has driven the conservation of mobulids forward, resulting in the listing of all manta and devil rays in the Appendices of the Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). He is the author of two books; the award-winning *MANTA – The Secret Life of Devil Rays*, published in 2017, and *the Guide to Manta and Devil Rays of the World*, published in 2018, and he has also published over 40 peer-reviewed research papers.

About Manta Rays



1

Pectoral fins

Their powerful wing-like fins mean mantas can reach speeds of up to 25 km/h when escaping from threats

2

Eyes

Mantas can roll their eyes back into their sockets if they find that something has touched or injured them. Behind their eyes are situated a series of tiny pits called ampullae of Lorenzini, sensory organs called electroreceptors that detect electric fields in the water

3

Cephalic fins

These can be identified easily as the huge spoon-like fins near the manta's mouth. They aid in funnelling plankton-rich waters into their mouths

4

Gills

Mantas are filter feeders; water enters through their mouth as they glide and exits through their gills. Special thin cartilage filaments known as gill plates filter zooplanton from the water

5

Tail

Contrary to popular belief, the tails of mantas are completely harmless! They do not have a barb and they definitely do not sting

6

Dorsal fin

Unlike the large pectoral fins that act as "wings" for swimming, the dorsal fin is much smaller and primarily serves to help stabilise the ray, though its exact function is not fully understood

7

Skin

Manta skin is shielded with tooth-like scales called dermal dentacles. These reduce drag, allowing for greater efficiency in swimming

8

Brain

The brains of mantas are the biggest of any fish. In fact, the manta's brain is disproportionately large when compared to its body weight and this can be credited to their many higher functions such as sensory purposes

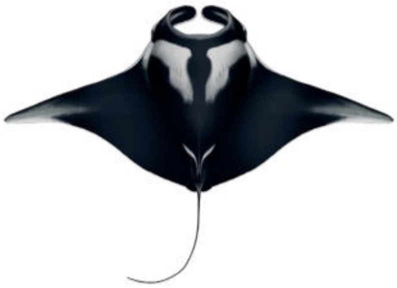
Mobula Genus

Kingdom : **Animalia**
Phylum : **Chordata**
Class : **Chondrichthyes (cartilaginous fish; sharks, rays, skates, sawfish & chimaeras)**

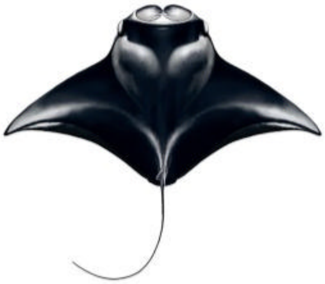
Subclass : **Elasmobranchii (sharks, rays, skates & sawfish)**
Division : **Batomorphi (all rays)**
Order : **Myliobatiformes (stingrays)**
Family : **Mobulidae (devil rays & manta rays)**
Genus : ***Mobula***

10 SPECIES

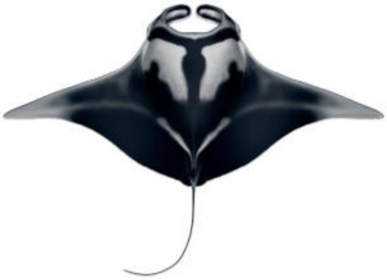
Mobula birostris
(oceanic manta ray)



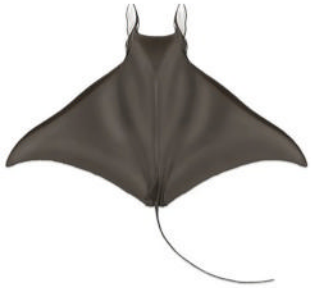
Mobula alfredi
(reef manta ray)



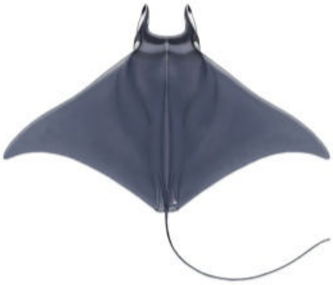
Mobula yarae
(Atlantic manta ray)



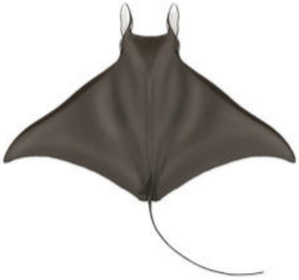
Mobula eregoodoo
(long-horned pygmy devil ray)



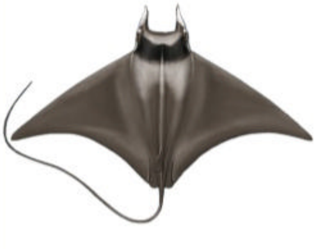
Mobula hypostoma
(Atlantic devil ray)



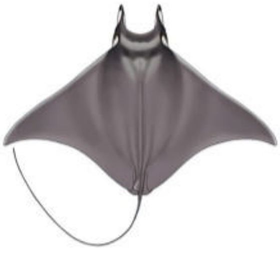
Mobula kuhlii
(short-horned pygmy devil ray)



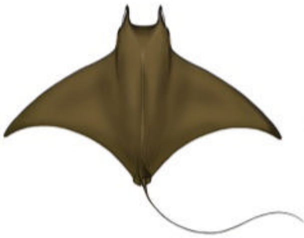
Mobula mobular
(spinetail devil ray)



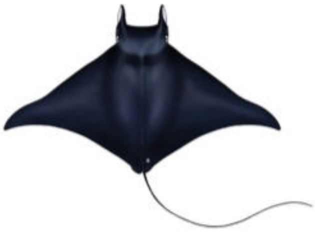
Mobula munkiana
(Munk’s pygmy devil ray)



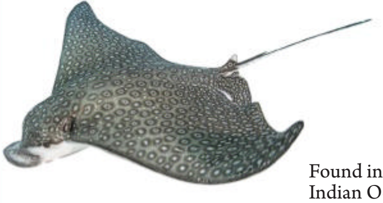
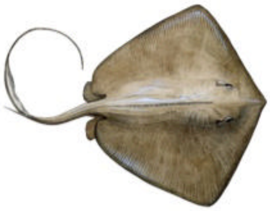
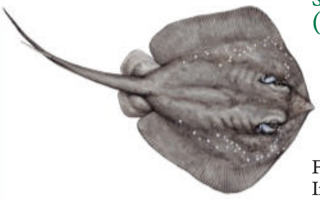
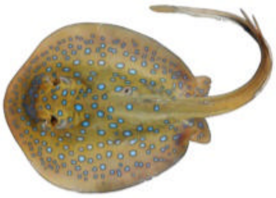
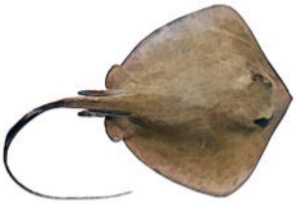
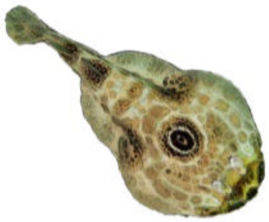
Mobula tarapacana
(sicklefin devil ray)



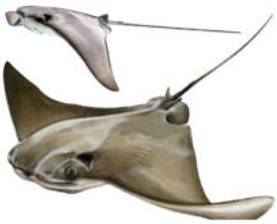
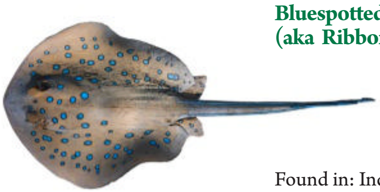
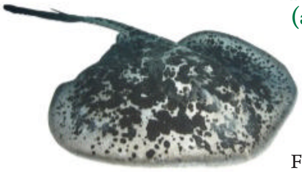
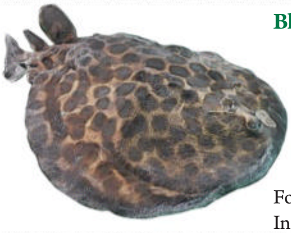
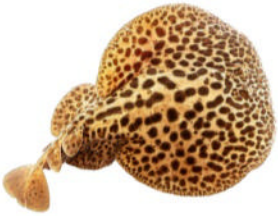
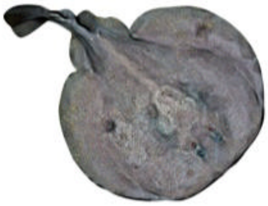
Mobula thurstoni
(bentfin devil ray)

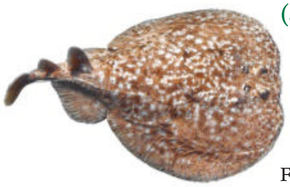
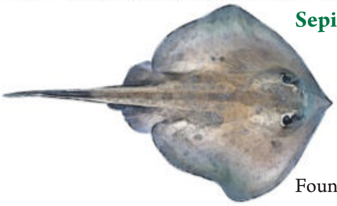
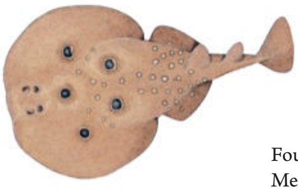
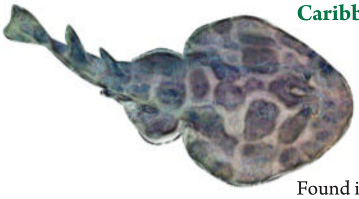
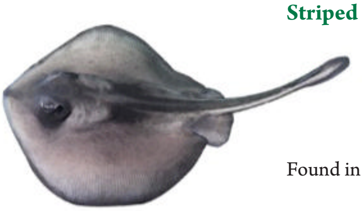
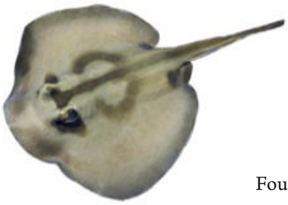


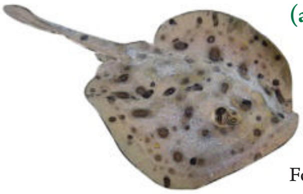
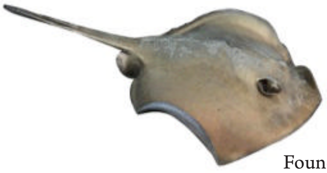
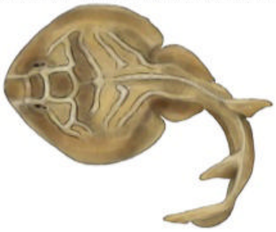
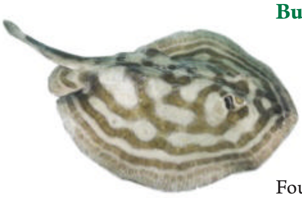
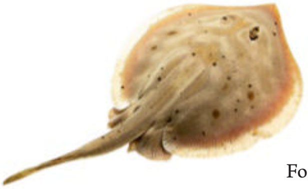
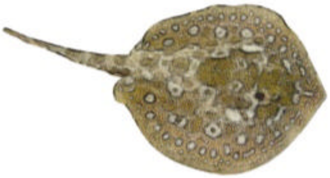
More Than Mobulids

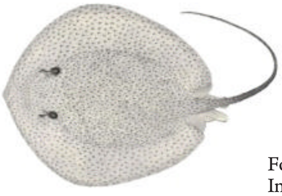
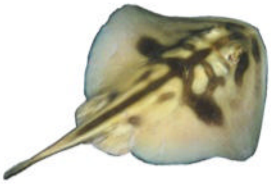
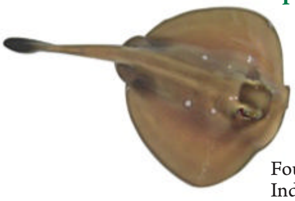
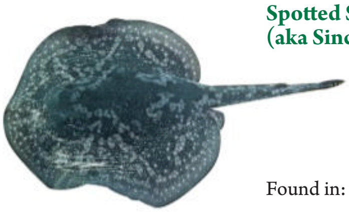
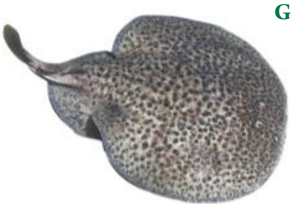
	Common Name	Scientific Name	Distinctive Features
	**Spotted Eagle Ray** Found in: Atlantic Ocean, Indian Ocean, Pacific Ocean	*Aetobatus narinari*	Flat, blue-black/black disc-shaped body with white spots on its top side Flat snout, similar to that of a duck bill
	**Southern Stingray** Found in: Atlantic Ocean	*Dasyatis americana*	Body is a flat, diamond-shaped disc in a mud brown/olive/grey surface colour Barb on its slender tail is serrated and covered in a venomous mucous
	**Smooth Stingray (aka Short-tail Stingray)** Found in: Atlantic Ocean, Indian Ocean, Pacific Ocean	*Dasyatis brevicaudata*	Its tail is usually shorter than its plain-coloured disc-shaped body and thick at the base Tends to remain within a relatively limited area throughout the year and is not known to engage in long migrations
	**Bluespotted Maskray (aka Bluespotted Stingray)** Found in: Indian Ocean, Pacific Ocean	*Dasyatis kuhlii*	Body is light-green with blue spots; at times confused with the bluespotted ribbontail ray (*Taeniura lymma*) Unlike many other rays, they rarely bury themselves in the sand
	**Bluntnose Stingray** Found in: Atlantic Ocean	*Dasyatis say*	Tail is extremely long and whip-like Has generally nocturnal habits and spends much of the day buried in the substrate
	**Bullseye Electric Ray (aka Ocellated Electric Ray)** Found in: Atlantic Ocean	*Diplobatis ommata*	The upperside of its body is marked in the centre with a distinctive bulls-eye On either side of its head, there are two internal kidney-shaped organs, which are actually responsible for generating electric shocks

	Common Name	Scientific Name	Distinctive Features
	Short-Tail Electric Ray (aka Coffin Ray) Found in: Atlantic Ocean	*Hypnos monopterygius*	Endemic to the waters of Australia Body shape is not disc-like, but pear-shaped and its body is coloured in varying shades of brown
	Lesser Electric Ray Found in: Atlantic Ocean	*Narcine bancroftii*	As in other electric rays, the body lacks scales and the upper surface varies from dark brown to reddish orange in colour while its underbelly is white to yellowish or greenish The shock it produces has been known to cause severe pain in humans, although it usually peaks at just 14 to 37 volts
	Cortez Electric Ray (aka Giant Electric Ray) Found in: Pacific Ocean	*Narcine entemedor*	Its body colouration is generally greyish tan to brown on the surface; some individuals have several pairs of faint ocelli This species is believed to be nocturnal and spends the day half-buried under sand
	Feathertail Stingray (aka Cowtail Stingray) Found in: Indian Ocean, Pacific Ocean	*Pastinachus sephen*	Its most distinctive characteristic is the large, flag-like ventral fold on its tail This species is considered to be particularly dangerous as its long tail is capable of reaching over its back to strike anything (or anyone) gripping it from the front
	Thornback Ray (aka California Thornback) Found in: Pacific Ocean	*Platyrhinoidis triseriata* or *Raja clavata*	Three parallel rows of large, hooked thorns start from the middle of this species' back and run onto its tail Known to be generally harmless and docile, making it a popular choice in aquariums
	Giant Shovelnose Ray (aka Common Shovelnose Ray) Found in: Indian Ocean, Pacific Ocean	*Rhinobatos typus*/ *Glaucostegus typus*	Reported to attain at least 270 centimetres in length This species has also been reported to be able to live and breed permanently in freshwater

	Common Name	Scientific Name	Distinctive Features
	**Pacific Cownose Ray (aka Golden Cownose Ray)** Found in: Pacific Ocean	*Rhinoptera steindachneri*	Migratory species that largely inhabits shallow coastal waters Little is known of the species, which is the only representative of its family known from the eastern Pacific
	**Bluespotted Ribbontail Ray (aka Ribbontailed Stingray)** Found in: Indian Ocean, Pacific Ocean	*Taeniura lymma*	Large, bright, iridescent blue spots all over its oval, elongated body; blue stripes also run along either side of its tail, which has venomous spines at the tip In its mouth there are two plates that are used for crushing shells of crabs, prawns and molluscs
	**Marbled Ribbontail Ray (aka Blotched Fantail Ray)** Found in: Indian Ocean, Pacific Ocean	*Taeniura meyeni* / *Taeniurops meyeni*	Has a circular-shaped disc that has a mottled pattern of black, grey and white spots/blotches on its surface, while the tail is uniformly black behind the sting A deep and prominent skin fold runs along the underside of its tail
	**Blackspotted Torpedo Ray** Found in: Southern Africa, Indian Ocean	*Torpedo fuscomaculata*	The colouration of this electric ray is generally yellowish or reddish-brown above, with numerous closely packed dark spots
	**Marbled Torpedo Ray (aka Spotted Torpedo)** Found in: Atlantic Ocean	*Torpedo marmorata*	This electric ray's dark brown mottled colour pattern makes it distinctive – though some individuals are plain-coloured Known to be a nocturnal, slow-moving, solitary creature which can survive in environments with very little dissolved oxygen, like tidal pools
	**Atlantic Torpedo Ray (aka Great Torpedo Ray)** Found in: Atlantic Ocean, Indian Ocean, Pacific Ocean	*Torpedo nobiliana*	One of the largest electric rays known, this species' uniform dark colour makes it distinguishable Juveniles generally inhabit shallower, sandy or muddy habitats, whereas adults are more pelagic in nature and frequent open water

	Common Name	Scientific Name	Distinctive Features
	**Panther Torpedo Ray (aka Leopard Torpedo)** Found in: Atlantic Ocean, Indian Ocean, Pacific Ocean	*Torpedo panthera*	The stout tail is very short compared to the length of its body and bears a well-developed fin at the tip It is an ovoviviparous fish, and the young hatch inside the female and are then "born" live
	**Sepia Stingray** Found in: Atlantic Ocean	*Urolophus aurantiacus*	Generally only found in small numbers with a patchy occurrence in suitable habitat
	**Ocellate Torpedo Ray** Found in: Atlantic Ocean, Mediterranean, Black Sea	*Torpedo torpedo*	Easily identified by its prominent blue spots on the surface of its disc-shaped body, which usually number five but may vary from zero to nine Able to deliver a powerful electric shock of up to 200 volts
	**Caribbean Electric Ray** Found in: Atlantic Ocean	*Narcine bancroftii*	Also known as the lesser electric ray or torpedofish, this ray has a circular, flattened body with the two pectoral fins fused to it, and is characterised by a moderately long snout, which distinguishes it from other species Behind the rounded body are two equal dorsal fins which attach to a relatively short tail with a triangular caudal fin
	**Striped Stingaree** Found in: Australia	*Trygonoptera ovalis*	Characterised by an oval, greyish to brownish disc with darker mask-like markings around the eyes and a pair of blotches at the centre of the disc that run down by either side of its spine as horizontal lines
	**Kapala Stingaree** Found in: Australia	*Urolophus kapalensis*	The colour of this species is greenish above, with a highly variable pattern of dark markings usually found outside and between the eyes, and over its back and tail Its pectoral fin disc is somewhat diamond-shaped with rounded outer corners

	Common Name	Scientific Name	Distinctive Features
	**Cortez Round Stingray (aka Spotted Round Ray)** Found in: Pacific	*Urobatis maculatus*	As its name suggests, the disc shape of this species is roughly circular, with a slightly angular snout Its body colour is brown or brownish grey, with variable, irregular, relatively widely spaced dark blotches and spots
	**Common Stingaree** Found in: Pacific Ocean, Indian Ocean	*Trygonoptera testacea*	Body is plain brownish to greyish and has a rounded pectoral fin disc with a broadly triangular snout As a juvenile, its diet consists almost entirely of shrimp, and as it matures it feeds predominantly on polychaete worms
	**Southern Fiddler Ray (aka Banjo Shark)** Found in: Pacific Ocean	*Trygonorrhina fasciata*	Its body is brown with shades of yellow/olive above, with pale lilac bands around with dark brown edges and a distinctive triangular pattern behind its eyes This species reaches a length of 126 centimetres
	**Bullseye Stingray** Found in: Pacific Ocean	*Urobatis concentricus*	Its disc is circular in shape and is generally light grey in colour with blackish blotches and spots arranged in concentric rows Skin is smooth and spine-free but a long, venomous spine is located about halfway down its tail
	**Round Stingray** Found in: Pacific Ocean	*Urobatis halleri*	A relatively small ray (up to 31 centimetres disc width) with a large tail spine This species is strongly believed to be segregated by age and sex in the wild, with the females staying in water deeper than 14 metres and males and juveniles in shallower habitats
	**Yellow Stingray** Found in: Atlantic Ocean	*Urobatis jamaicensis*	It has a highly variable but distinctive dorsal colour pattern consisting of either light-on-dark or dark-on-light reticulations forming spots and blotches It has been suggested that it attracts prey by raising its snout to create a shady, "cave"-like area for small fish to hide

	Common Name	Scientific Name	Distinctive Features
	**Porcupine Ray** Found in: Pacific Ocean, Indian Ocean	*Urogymnus asperrimus*	Distinctive, thorny projections found on the upper-side of its body Its tail, unlike most members of the stingray family, does not possess a venomous barb
	**Banded Stingaree (aka Crossback Stingaree)** Found in: Australia	*Urolophus cruciatus*	When threatened, it raises its tail above its body to warn predators, just like a scorpion does
	**Sparsely-spotted Stingaree** Found in: Pacific Ocean, Indian Ocean	*Urolophus paucimaculatus*	Distinctive bell-shaped curtain of skin between the nostrils
	**Spotted Stingaree (aka Sinclair's Stingaree)** Found in: Indian Ocean	*Urolophus gigas*	Can be readily distinguished by its nearly circular, dark-coloured pectoral fin disc, which is decorated with a complex pattern of white/cream spots
	**Gulf Torpedo** Found in: Indian Ocean	*Torpedo sinuspersici*	Its body is beautifully adorned with cream or golden circles and irregular marks against a dark red or blackish-brown background A slow-moving ray, it has a shark-like tail that is short and stout

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in the Black Sea
possess morphological
differences from Atlantic
and Pacific populations

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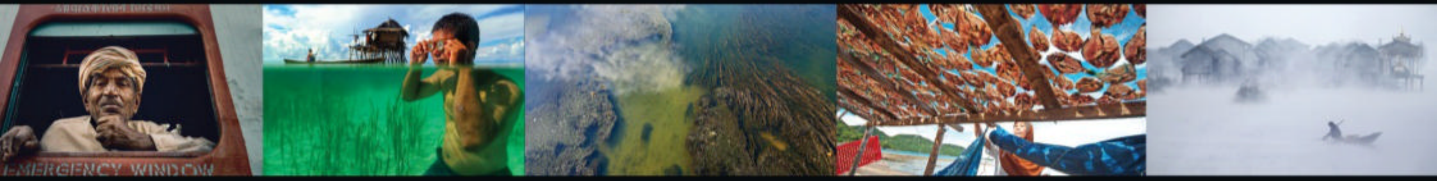

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